SEP 19 1930

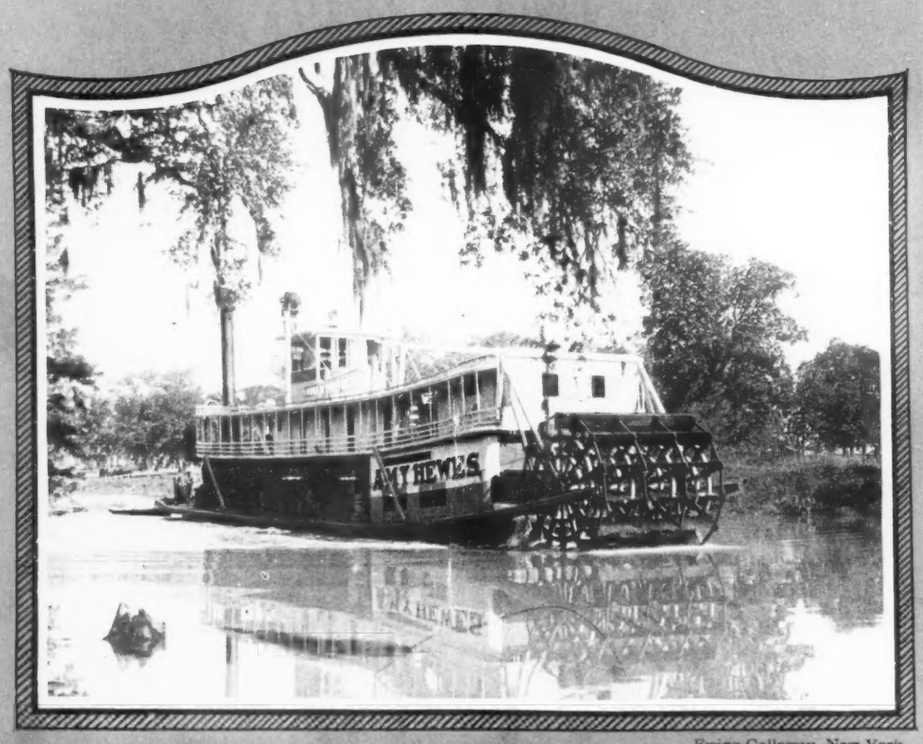
Compressed Air Magazine

Engineering Library

Vol. XXXV, No. IX London New York Paris 35 Cents a Copy

SEPTEMBER, 1930

CIRCULATION THIS ISSUE
31,951 *COPIES*



Ewing Galloway, New York

OLD-TIMERS POINT WITH PRIDE TO SHALLOW-DRAFT STERN-WHEEL STEAMERS OF THIS SORT THAT STILL PLY SOUTHERN WATERS

Difficult Job Completed at Trunk-Line Terminal
R. G. Skerrett

Constructing a Scenic Highway in the Adirondacks
S. Mornington

Aftercooler Worth While in Stone-Cutting Plant
A. S. Taylor

How Rock Asphalt is Quarried in State of Texas
C. H. Vivian

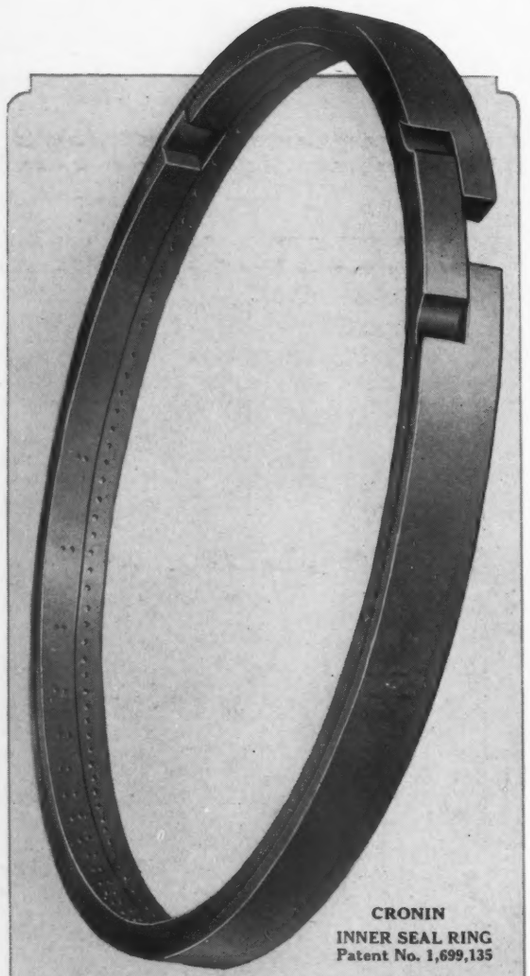
(TABLE OF CONTENTS AND ADVERTISERS' INDEX, PAGE 26)

Why Use Hammered Piston Rings

A PISTON RING must have tension —which means equal outward pressure uniformly exerted against the cylinder wall. Furthermore, the tension must be maintained during the life of the ring and under the most severe service.

Hammered tension is the answer. Hammering the inner surface of the ring by the special American Hammered process produces uniform and permanent tension. Permanent because the inner surface of the ring is not affected by wear, the useful tension being maintained during the life of the ring.

Engine builders and operators have demonstrated through years of experience that the hammered principle is more than a scientific theory. It is a proven fact. That is why a large and steadily increasing number of America's leading engine builders use millions of American Hammered Piston Rings year after year.



CRONIN
INNER SEAL RING
Patent No. 1,699,135

Multiple-Piece Rings

FOR more than ten years, multiple-piece rings manufactured by the American Hammered process have been supplied to leading engine builders.

The Cronin Inner Seal Ring pictured effectively seals the joint, the groove, and the cylinder and also overcomes excessive groove wear. It can be used in all grooves in the piston and is indispensable in out of round and tapered cylinder.

American Hammered Piston Rings

THE AMERICAN HAMMERED PISTON RING COMPANY · · · BALTIMORE, MARYLAND, U. S. A.

BRANCHES

215 Market St., San Francisco, Cal. 7338 Woodward Ave., Detroit, Mich. 11 Moore St, New York City, N. Y. 826 E. First St., Tulsa, Oklahoma
501 Pico St., Long Beach, Cal. 800 W. Rio Grande Ave., Fort Worth, Tex. 148 Pearl St., Boston, Mass. 524 Poydras St., New Orleans, La.

As It Seems To Us

CITYWARD DRIFT OF POPULATION

THE welfare of the farmer has been the outstanding concern of politicians latterly—if we can judge correctly by their speeches on numerous and varied occasions; and we are well aware that the National Government and economists of diversified degree are keenly alert to the aliveness of the problem. Without the farmer the town and city dweller would be hard put to it for his daily subsistence; and this fact emphasizes the significance of some of the data recently gathered by the Bureau of the Census.

An analysis of the figures obtained by the enumerators discloses that there is a very marked and increasing drift from farms to cities and to lesser organized communities that offer other ways of making a livelihood. While the situation in New York State may not be strictly typical of conditions the country over, still it warrants pause and pondering. New York State has a population of 12,609,555, while New York City has an ascertained population of 6,958,792—the Metropolis, in short, has within its expansive area a trifle in excess of 55 per cent of the total population of he whole State!

This drift cityward has been growing more pronounced in the last decade. Between 1920 and 1925 there were 3,527 fewer operated farms—representing that measure of abandonment of agriculture. Between 1925 and 1930, farms deserted numbered 17,884 in 45 counties of the State. Not only do urban communities appeal to the rural population, but normally the industries and the businesses of towns and cities offer employment to persons moving in from the country, and there are other attractions that are part and parcel of life in the larger places. Isn't this movement inevitably going to increase the demand upon the farmer who remains upon the land? And, assuming that his methods are efficient, isn't he going to be the better off because of the certainty of a market for his produce?

GOGGLES A HANDICAP

DATA collected by the National Society for the Prevention of Blindness and the National Safety Council reveal that the wearing of goggles by workers in certain occupations probably saved the sight of the wearers in 7,411 accidents during the years of 1926 and 1927. The figures were obtained from 583 plants employing an aggregate of 578,396 men. In 4,654 of the recorded cases, one lens of the goggles was damaged, and in the remaining 2,757 cases both lenses were shattered or injured. The severity of the breakage of the lenses justified the assumption that loss of vision would have occurred in one or both eyes had the glass not been there to halt or to greatly diminish the force of the blow.

The foregoing figures make clear the protective value of goggles; but the Bureau of Labor Statistics points out, while commenting upon the benefit of the lenses, that they are at best a handicap to the wearer. For that reason the Bureau urges a revision of manufacturing processes, the redesigning of machines or tools, or the adoption of safeguards at the point of operation, that will make the wearing of goggles unnecessary. Theoretically, this is sound reasoning, especially when it is recalled that goggles are often smudged with grease and dirt, and vision impaired correspondingly.

All the same, we hope that the wearing of goggles will not decrease in any mistaken belief that the desired mechanical millenium is just around the corner. We should bear in mind that a compensatory money loss of $18,026,700 has been obviated within the interval mentioned by the use of goggles, whether they constituted a handicap or otherwise to the worker.

VALUE OF EDUCATIONAL EXAMINATIONS

NOW that the summer is drawing to a close in the temperate zone north of the Equator, hundreds of thousands of youths are turning back to their textbooks and to the next higher grade in the line of educational seniority. A great many of them must pass examinations of one sort or another—generally supposed to be the surest way of ascertaining the individual's knowledge of any subject. It may be a source of comfort to a goodly number of the unhappy participants in these recurrent trials to learn that there are numerous educators that do not believe in examinations as a way to find out what a person knows and, especially, how well he can apply that knowledge.

At a recent convention of educators, one well-known authority was decidedly outspoken in his disapproval of so-called intelligence tests. Let us quote just what Dr. CHARLES M. STEBBINS said: "From my standpoint, there is no such thing as an intelligence test because it is impossible by any mechanical process to determine the mental status of pupils." While this educator declared that he would retain such tests merely for supplementary purposes, still he expressed the belief that it would be a serious mistake to attach much importance to them.

There are fads in educational practices just as there are fads in other directions; and while none may have all the virtues claimed for it by its advocates nevertheless each has been devised and developed in an honest effort to evaluate the mental capacity of the individual in order that his work may be planned so as to strengthen him where weak and to direct him into channels that will make the most of his natural aptitude. The ultimate aim is to avoid that waste of effort that inevitably follows an essay to put a square peg in a round hole and to make it fit.

PLAN TO STRAIGHTEN PART OF THE RIO GRANDE

ONE must see the Rio Grande River during a freshet to find warrant for the imposing name it bears. For months running the stream has only a meager flow. However, when on the rampage, this international boundary between Texas and Mexico has a way of suddenly cutting new channels for itself—taking large tracts of bottom land from one country and placing them under the jurisdiction of the other one. This not only makes for confusion of property rights but it invites difficulties in the policing of the border. A certain amount of smuggling goes on continually, despite vigilance; and the nature of some of this becomes self-evident when one is reminded that Mexico is wet no matter what may be the seasonal status of the Rio Grande.

A joint report has recently been made by a commission of Mexican and American engineers in which a plan is offered for stabilizing and straightening the flow of the Rio Grande between El Paso and Quitman Canyon—a distance of a little more than 100 miles, as the crow flies. To carry this project to completion would entail the construction of a channel, flanked with suitable banks, and the excavating of 13,700,000 cubic yards of earth. In addition, there would be an impounding dam, designed to regulate the river during flood periods. The estimated cost of the improvement, including the acquisition of certain tracts of land, would call for an expenditure of approximately $7,000,000.

The advantages likely to accrue from the work are thus stated in the engineers' report: "Enforcement of the national laws of each country would be facilitated by the shortened and controlled channel, with roadways on the levee embankments permitting greater accessibility and constant inspection. Additional velocities are created to transport accumulations of sediment, preventing future channel changes and detachment of areas from one country to the other. Drainage and irrigation of additional land in both countries are permitted; and the annual flood menace to public and private improvements is eliminated."

The scheme has much to commend it; and, from an engineering point of view, the work should prove interesting.

Excavating a ledge along the route of the Stratford-Pine Lake road in the Adirondack Mountains of New York State. Drilling deep holes with an X-71 drifter mounted on a tripod.

Left—A 10x8-inch Ingersoll-Rand portable furnishing air for rock drills clearing the right of way.

Right—Section of the new highway with rock sub-base in place.

Building Mountain Road That Has Called For Continual Use of Rock Drills

Stratford-Pine Lake Highway, Now Under Construction in the Adirondacks, Is Said to Be an Exceptionally Difficult Undertaking

By SIDNEY MORNINGTON

NEW York State is spending millions of dollars in building roads to make the scenic wonders of the Adirondack Mountains more accessible to the motoring public. They are intended to constitute a chain of highways formed of units of varying lengths; and one of these units is the road now under construction, in Fulton County, between Stratford and Pine Lake—a stretch of 9.2 miles.

As roads go nowadays, one of ten miles or less is not primarily anything about which to boast; but in this particular case the job is commonly considered the toughest one in the whole of Division No. 2 of the Highway Department of the State of New York. Division No. 2, let it be said, embraces much mountainous and difficult country. The contract was awarded the Miller Brothers Construction Company, of Hartford, Conn., in April of 1929; and immediately afterwards part of that large organization moved in and began work. Operations have been carried on continuously since that date; and, unless too severely hampered by the weather, the contractor expects to have the road completed by the summer of 1931.

The business motto of the Miller Brothers Construction Company is: "We move the Earth". The term earth, in the case of the Stratford-Pine Lake road, doesn't mean just soil—it includes a tremendous amount of rock, and decidedly hard rock at that. Indeed, physical conditions make clear just why no road has hitherto joined Stratford and Pine Lake. There is a road that covers half of the intervening distance, but its projectors never carried it farther than Pleasant Lake, where there is an aggregation of summer camps. Even so, that modest route was made to follow the line of least resistance, studiously dodging outcropping rock; and it is still largely of corduroy construction. In short, that road merely adapted itself to surface conditions and to alterations that could be made in them with such modest tools as picks and shovels.

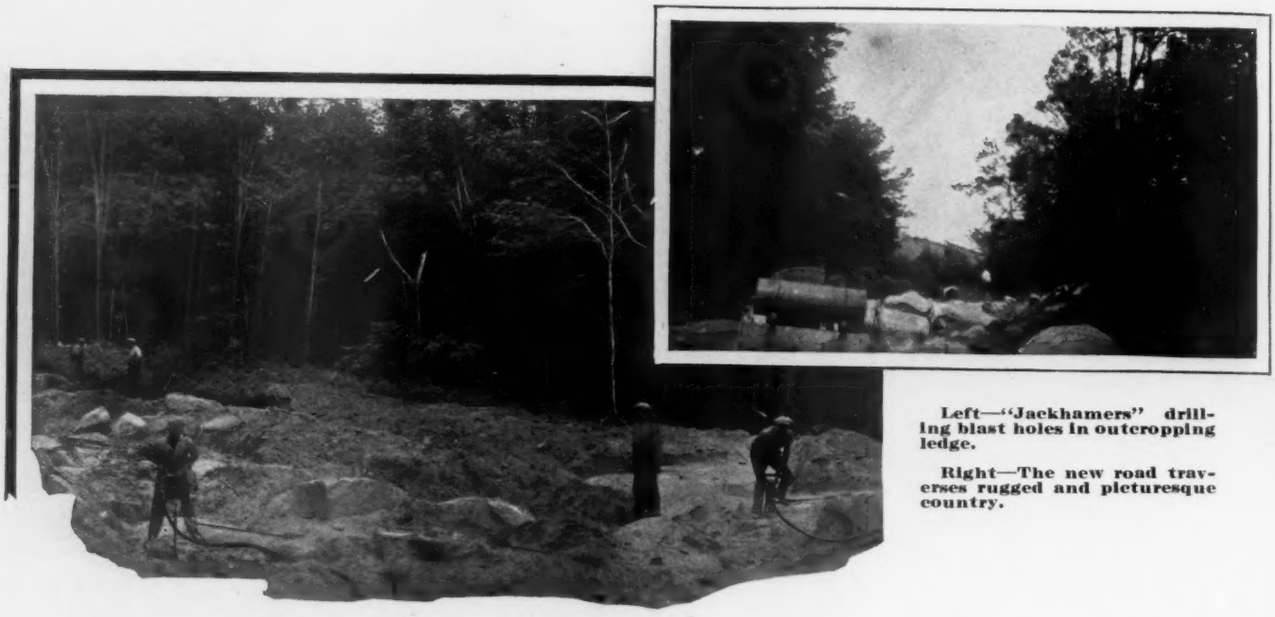
The road now building was laid out by engineers who subscribe to the geometrical dictum that a straight line is the shortest distance between two points; and when the surveyors of the Highway Department of the State of New York set out to stake the route, their task proved anything but an easy one. They had to blaze their way through a veritable wilderness covered with splendid stands of beech, birch, balsam, and spruce—some of the birches subsequently felled measuring as much as 4 feet through at the stump. Before the line was traced all the way to Pine Lake, an unimagined amount of rock was encountered; and the contractor's operations have uncovered a vast deal more of it.

FROM Stratford to Pine Lake, in the Adirondack Mountains, there is now building a road calling for the excavating of an exceptionally large proportion of rock. Indeed, the contract is considered the toughest job in that division of the State Highway Department.

The present article describes the conditions in some detail and explains how the contractor has equipped himself to meet the situation. Despite the natural handicaps, the work is being carried forward at a commendable pace; and there is every reason to believe that this beautiful route through rugged country will be ready for use by the summer of 1931.

Up to the time the scene of activities was visited six weeks ago, the contractor had cut the roadway through from Stratford to Pine Lake, and the grading was about 70 per cent completed. In doing that work it was necessary to traverse no less than four miles of virgin timber—pioneer work, in fact. The rock encountered is gneiss, which tells the story of the igneous origin of the Adirondacks and bears mute testimony to the manner in which the whole region has been subjected to the protracted and the enormous pressures of eroding ice during successive glacial periods. There is one rock cut that is fully half a mile in length and that has been drilled and blasted to a maximum depth of 25 feet in order to reach the gradient prescribed for the highway.

We are indebted to Mr. Harvey H. Glosser, engineer in charge for the Highway Department, for most of the following information concerning the general characteristics of the



Left—"Jackhamers" drilling blast holes in outcropping ledge.

Right—The new road traverses rugged and picturesque country.

road and the conditions encountered by the contractor. Rock drilling has been virtually continuous since the undertaking was started in April of last year; and to carry the project forward as rapidly as practicable work directly on the road has been pushed with two shifts daily—one coming on at 7 a. m. and quitting at 6 p. m., and the other beginning at 7 p. m. and leaving at 6 a. m. All told, the 9.2 miles of highway will involve the disposal of 100,000 cubic yards of rock, of which 55,000 cubic yards will be taken from the cuts.

The road is to be of the bituminous-macadam type composed of a 9-inch sub-base surmounted by a 3-inch bottom course, and that overlaid with a 3-inch top layer of crushed rock. The top layer will receive a total of 2¾ gallons of bituminous material on each square yard of surfaced roadway—2 gallons being for penetration and the ¾ gallon remaining serving to form a seal coat. When finished, the road generally will have a width of 18 feet, with a 5-foot shoulder on each side. On curves, as is customary, the road will be wider. The heaviest climb is an 8.2 per cent grade, which is in the Village of Stratford where the road begins its eastward course to Pine Lake.

The right of way is 66 feet wide for five miles out from the village, and from there on to Pine Lake the right of way is 100 feet wide. The added 34 feet, while costing little if any more, has its advantage. A wider right of way permits the cutting of more timber, and this facilitates keeping the road drier. It does not, like the narrower section, tend to hold or trap snow and so prolong the presence of water. Furthermore, the wider section permits safer and better shooting of the rock and lightens in some respects the problems and the responsibilities of the contractor.

Distributed at different points along the highway there are seven bridges of three types. The longest one is of the pony-truss type and has a span of 110 feet. This bridge is in the Village of Stratford, and crosses East Canada Creek. The other bridges are either of I-beam or reinforced-concrete-slab construction. In the case of one of the I-beam bridges considerable difficulty has been encountered in securing a satisfactory foundation. It has been necessary to go down 12 feet—more or less— below muck and glacial drift to reach rock. The work has called for the construction of a cofferdam on each side of the creek and for the building of a flume to carry the flow in the meanwhile. The stream is of a "flashy" nature, and, therefore, subject to rapid and marked differences in the volume of water to be provided for. The bridge over this creek is the last to be completed. Work on drainage structures—such as culverts and the like, is substantially 75 per cent finished. The contract price for the job is the moderate one of $500,000. As Mr. Glosser expresses it: "The Miller Brothers Construction Company is an efficient concern, and it is doing all that the State asks."

The contractor is represented by Mr. A. C. Sternberg, a member of the firm, and he has been on the job ever since operations were started. His field office is at the crusher plant, which is located two miles or more outside of Stratford; but Mr. Sternberg is generally to be found somewhere out on the road. We don't know how he looks upon his task as a whole, but he made us aware of his enthusiasm when it came to giving us details about the operation of his stone-crushing plant. The plant gets out on an average 400 tons of rock daily; and the primary source of power in that isolated section of the country is an Ingersoll-Rand PO oil engine of 110 hp. That engine, according to Mr. Sternberg, had been run three years without a bit of trouble, and was then overhauled and put to work again on the present job. It is frequently subjected to a heavy overload; but so far it has never balked. It uses on an average about 3 gallons of fuel oil an hour; and oil costs 8 cents a gallon delivered at the power plant.

One of the several Thew Lorain shovels on the job digging trenches and handling rock.

The oil engine drives an 18x32-inch Acme primary crusher and a smaller No. 10½-D secondary crusher. In addition to that, it drives a line shaft from which a 10x10-inch ER compressor is belt driven. The

1—In the blacksmith shop. An improvised drill press, equipped with a CSB drill for odd jobs. 2—The blacksmith shop conditions daily 600 drill steels, and this is made possible by a No. 25 oil furnace and a No. 50 Ingersoll-Rand sharpener. 3—A load of reconditioned drill steels about to be distributed at points on the road. 4—This 10x10-inch ER compressor provides air for the blacksmith shop and for inflating pneumatic tires. 5—The prime mover at the crushing plant is an Ingersoll-Rand 110-hp. PO oil engine.

Left—Where the road encounters rock on either hand, with a stretch of sub-base in place.

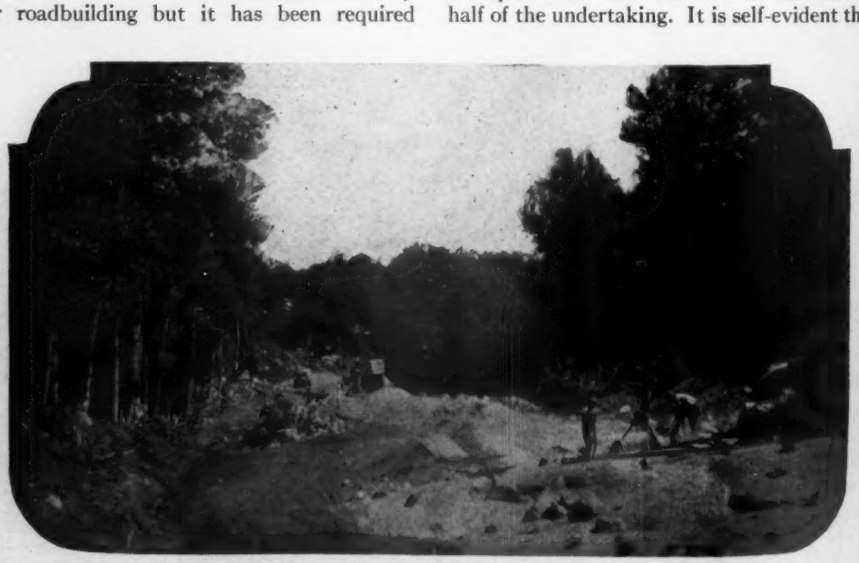
Right—Sub-base in process of completion.

Circle—The stone-crushing plant that draws much favorable comment from appreciative visitors.

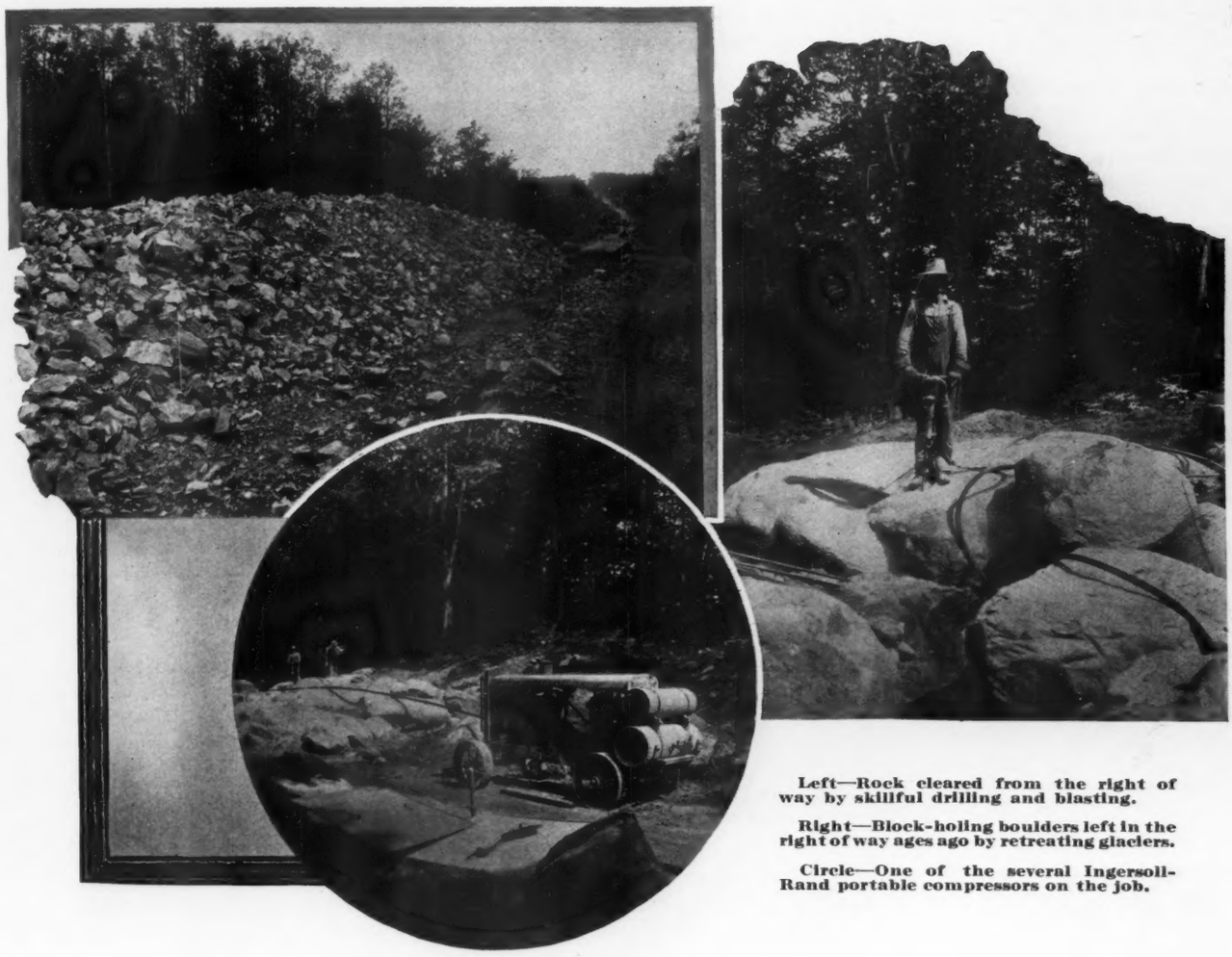
compressor furnishes air to operate a No. 50 Ingersoll-Rand sharpener and a No. 25 oil furnace in the blacksmith shop; and compressed air from the same source is utilized to blow up the tires of motor vehicles. The sharpener reconditions daily around 600 drill steels. The steels are of 1 and 1¼ inches, and now range from 2 feet to 12 feet in length. Steels 20 feet long have been used in certain of the deep rock cuts.

Strange as it may seem, there is no quarry in connection with the rock-crushing plant, as is usually the case in undertakings of a similar nature. The reason for this departure from common practice is that sufficient rock is excavated in opening up the roadway. To some extent this is amplified by weathered stones drawn from the fences or piled walls of neighboring farmlands. The rock is delivered to a convenient platform whence it is dumped into the primary crusher. From the primary crusher, the rock is fed to a bucket conveyor that carries it to the trommel, which screens it into the four sizes required—namely, ¾-inch, 1½-inch, 2¾-inch, and 3¾-inch, respectively. Tailings from the trommel are transported by belt conveyor to the secondary crusher, and from that crusher the rock is lifted back to the primary crusher from which it goes once more to the screen. The belt conveyor that takes the rock from the secondary crusher to the primary crusher is driven by a small gasoline engine.

Mr. Sternberg has been repeatedly complimented upon his crusher layout by visitors familiar with kindred operations; and it is unquestionably true that the dependable working of that equipment has contributed in no small measure to the progress of the work in hand. Crushed stone is needed not only for roadbuilding but it has been required wherever concrete has been employed for bridges and culverts. The fixed location of the rock-crushing plant, only about one-fourth of the length of the road from Stratford, has been found generally satisfactory up to the present time; but one naturally wonders whether it will prove equally so when stone is required for the roadbed on the eastern half of the undertaking. It is self-evident that



Picturesque, yes, but full of rocky obstacles that must be removed to make vehicular travel possible.



Left—Rock cleared from the right of way by skillful drilling and blasting.

Right—Block-holing boulders left in the right of way ages ago by retreating glaciers.

Circle—One of the several Ingersoll-Rand portable compressors on the job.

the crushed stone will have to be moved farther and farther, and possibly the raw material may have to be hauled from a greater distance than is at present the practice. Of course, there is nothing to prevent shifting the whole equipment, because it was originally moved over a difficult stretch of road to the site it now occupies.

The handling of blasted rock and the digging of ditches and similar excavating has been done and will continue to be done with power shovels. There are three units of this sort on the job, and all are of the Thew Lorain type. They are gasoline driven, and have been found equal to all demands made upon them. The shovels have worked the year round, and their operators have experienced no trouble in getting them started in the dead of winter when the thermometer registered a goodly number of degrees below zero. Much of the soil disposed of by the shovels holds moisture for a long while and, therefore, dries out slowly. This is understandable because of the large amount of decayed vegetal matter in its composition. When once dry and properly drained the soil gives no trouble to the roadbuilder nor in road maintenance.

Only a few of the motorists that will use this road will appreciate what had to be done by the builder.

As previously mentioned, rock drilling has been a virtually continual performance ever since the Stratford-Pine Lake road was started. Most of this work is done with S-49 "Jackhamers" which answer very well for holes of moderate depth and for block-holing large boulders. The deeper holes, however, are drilled with X-71's, mounted on tripods, and with the 1¼-inch steels. The practice has been to space the drill holes sufficiently close so that, with suitable charges, they would insure the rock being well broken up by a blast. This procedure has served two purposes: it has made work comparatively easy for the power shovels and for the crushing plant, and it has greatly lessened the amount of secondary drilling required. Thus, skillful drilling has contributed substantially to operating economies.

Air for the driving of the rock drills has been supplied by a number of Type 20 Ingersoll-Rand portable compressors. The majority

of these are 10x8-inch machines. One of these units can provide sufficient air at a suitable pressure to operate efficiently either several S-49 "Jackhamers" or one X-71 drill. The mobility of the portable compressor facilitates shifting it from point to point as occasion demands. The portables have been operating ever since the work was started in the spring of 1929, and they are still going strong and in daily service. To adapt them to winter conditions it has been necessary only to add a small quantity of alcohol to the circulating water; and the operators have had no difficulty at any time in starting the compressors even during the very coldest weather.

Top—A fair sample of the massive boulders with which nature studded the right of way.
Bottom—The piers for the bridge at this creek had to be carried down through 12 feet of muck and glacial drift to bed rock.

What the Miller Brothers Construction Company is doing in the Adirondacks emphasizes how different are the circumstances in which similar undertakings were essayed 25 years ago, and how far the present road is removed in means and methods from the roads which were built in those same mountains when summer visitors, sportsmen, and tourists first turned to them in numbers a few decades back. The change that has come about in procedure is fundamentally due to the use of power equipment devised and developed to promote the drilling of rock, to speed up excavating, and to enable the hauling of essential materials over very indifferent roads. Caterpillar tractors have come into being that will travel over ground that would balk the sturdiest of power-driven trucks; and now we see the oil engine brought to a stage where it can be shipped to remote or nearly inaccessible places and there provide power at low cost for crushing rock and for other purposes.

When the Stratford-Pine Lake road is ready for the public a year hence—assuming normal weather conditions in the meanwhile, that highway will hook up with existing roads running to Canada Lake, Arietta, and Piseco, and will open territory leading to Speculator and to Indian Lake. While the hills are not towering ones as they are in the very heart of the Adirondack region, still the country is extremely rugged and picturesque and has, besides, the distinctive charms of age-old naturalness and seeming remoteness from centers of population. The present contract is a difficult one; but before the Miller Brothers Construction Company declares the task finished and turns the road over to the State for the enjoyment of the public it will be a job thoroughly well done.

BRIDGE-BUILDING BY TELEPHONE

THE Fort Lee-Fort Washington Bridge, across the Hudson River, is being erected "to the tune of the telephone bell". Every part of the great structure is interconnected by telephone; and this has so simplified the issuing of orders that what was first looked upon in the nature of an experiment now bids fair to become common practice. The distance from shore to shore at that point on the Hudson is something more than 3,500 feet, and the accepted methods of communication on undertakings of this kind—either by word of mouth or flag signals—were not considered adequate. Direct communication between New York and New Jersey was therefore established by means of a tie line with an exchange on either side and with six instruments—one at each anchorage and two on each tower, one at the base and the other at the top. This is known as the Bell System. By this arrangement it is possible for the chief engineer to give instructions or to confer with six of his associates without having them leave their posts.

But perhaps the greatest service rendered by the telephone on this big engineering project was during cable-spinning. This work calls for precision and quick action, and speed of communication is a vital factor. To facilitate these operations there was provided a so-called inside telephone system numbering 54 instruments. These were encased in metal and installed in shacks at points of vantage on top of the bridge towers. Connected to the regular switchboard, which was in charge of a competent woman operator, was a monitor board, and from this board a member of the engineering staff of the John A. Roebling's Sons Company, who did the cable-spinning, gave the orders and the messages that saw the work through to a successful conclusion.

A small gage, no bigger in size than a shaving-stick container, was the object of unusual interest at the opening session of the last annual meeting of the American Society for Testing materials held not long ago in Atlantic City, N. J. The diminutive magnetic instrument exhibited on that occasion is capable of measuring with accuracy the strain induced by a speeding 100-ton locomotive in the rails beneath it. This strain gage is the product of the Westinghouse Electric & Manufacturing Company, and records a movement of ten-thousandths of an inch.

Stone-Cutting Plant Finds Aftercooler Well Worth While

Moisture-Laden Air Formerly Hampered Workers and Increased Costs in the Cutting Shed of William Bradley and Son

By A. S. TAYLOR

Cutting black-and-gold marble column bases with air-driven tools.

MUCH more stone is cut in the City of Greater New York for local architectural purposes than most people are aware. Just because the structural steelwork for the municipality's skyscrapers and other monumental structures comes from afar, all ready to be assembled, there is a common belief that the carved and cut stone used to face these edifices or to adorn their interiors is also finished at remote cutting plants and shipped to the Metropolis for the masons to put in place. This assumption is an erroneous one.

It is probably no exaggeration to say that millions of cubic feet of architectural stone are turned out annually within the comprehensive limits of New York City; and there is ample warrant that the industry should flourish there. To begin with, rail and water facilities make it practicable and profitable to receive the roughly hewn blocks from which stone can be cut for local use; next, plants engaged in such work in the metropolitan area can rapidly obtain not only the power they need from dependable sources but an army of capable workers upon whom they can draw the year round. Finally, time and money can be saved by having certain of the stonework prepared at the latest permissible date so that it can be made to fit snugly against completed steelwork that has developed measurable variations from the dimensions and lines of the original architectural plans. More work of this nature is required than is generally realized.

Among the prominent concerns in the City of Greater New York that are engaged in getting out architectural stone is the widely known firm of William Bradley & Son, whose spacious plant is located in Long Island City, in the Borough of Queens. That establishment has its own wharf on the adjacent East River; and this facilitates the arrival of raw material from distant quarries and the transporting of cut stone to the neighboring waterfronts of the other metropolitan boroughs. The Bradley plant has occupied its present site for nearly a quarter of a century; and during that period of continually increasing service it has supplied cut stone for many of the outstanding structures of New York City.

Latterly, the firm has produced cut stone for the Cathedral of St. John the Divine, for the recently completed Riverside Baptist Church, for the Manhattan Company Building, for the Irving Trust Company Building, and for numerous other notable edifices. The stone cut has ranged the whole gamut employed in modern architecture, such as limestone, marble, and sandstone—each having its own physical characteristics and each calling for different handling on the part of the craftsmen engaged in carving and cutting it. The present trend in architectural embellishment demands both a wide range in color and the use of varied adorning forms and treatments. This not only necessitates skill on the part of the man with the chisel but it also calls for much care in surfacing certain of the stones used. Many of these have to be polished to a high degree to make the most of their textures and their distinctive hues. These particulars are mentioned only that one may have a fairly comprehensive grasp of the natures and treatments of finished architectural stone turned out by William Bradley & Son.

This drum-rubbing machine is used to surface large slabs of marble preliminary to polishing.

Some idea of the size of the Bradley plant can be had when we mention that the cutting shed is 260 feet wide and 610 feet long. The interior of this spacious shed is well lighted both naturally and artificially, and it is subdivided into a number of departments—each having to do with some particular phase of the firm's stone-

Top—Column sectors of black-and-gold marble being made ready for assembly on an octagonal core of limestone before being put in a lathe for finishing. Bottom—Centrifugal pumps raising water to elevated tanks after the water has been brought to the surface from deep wells by air lift.

cutting activities. Broadly stated, production has to do with the preparation of stone for architectural exteriors and for the cutting, carving, and polishing of stone for interiors—most of this stone being marble obtained both in this country and abroad. In this way, the plant is able to furnish marble of many different colors, such as are called for by modernistic decorative schemes.

No matter whether the stone is to withstand changing weather conditions or to be displayed indoors, its preparation calls for not only skill on the part of the operatives but, in numerous instances, also for the employment of specialized machinery. This is particularly true in the processes of sawing blocks into slabs, used for paneling, as well as in subsequently imparting to these slabs the high polish often needed to bring out the full beauties of veining and coloring. In sawing blocks into slabs the aim, of course, is to utilize the raw material to the fullest possible extent—that is, to have as little waste material as practicable. One of our illustrations shows how substantial economies are effected in sawing corner sections with gang saws. By sawing these right-angle sections in this manner wastage is reduced to a minimum, and the corners have the added architectural advantage of being solid instead of having mitered or lapped joints.

In a measure, many of the machines found in such a stone-working plant are virtually nothing more than modifications of kindred apparatus extensively used in machine shops and woodworking mills. They differ only in that they are adapted to cut, to plane, to turn, or to saw stone; and the tools are such as will best handle stone of different degrees of hardness. For instance, certain saws employed in cutting big slabs of marble are provided with carborundum teeth. Again, rapidly revolving carborundum wheels and saws with diamond-pointed teeth are utilized to cut, to trim, or otherwise to form the stone to meet given specifications.

In turning out columns of black-and-gold marble, for instance, each column is made up of a number of vertical sectors produced from large blocks of the material—each of which yields several sectors. After each sector has been given its exterior curvature, but before it is finally finished to dimension, four of them are assembled upon an octagonal core of limestone. The sectors are cemented to the limestone with plaster of Paris. With this done, the column is centered in a large lathe equipped with a carborundum wheel that gives the mass the ultimate measurement called for by the architect. When this work is completed only a trained eye is likely to discover where the sectors join. We reproduce a photograph of one phase of this interesting work.

Inasmuch as the plant is called upon to carve images and other large decorative features for churches, institutions, and other imposing structures, many of our readers will naturally wonder how these features are produced from models that are frequently made on a smaller scale. Where the scale of the model is smaller than that of the figure or design to be reproduced in stone, enlargement is effected with the aid of a pantographic instrument that can be adjusted to give any increase in size desired—the guiding dimensions being taken from fixed points on the model and transferred to corresponding positions on the stone to be cut. Again, where the carver has a full-size model to guide him, he utilizes what is known as a compass-pointing machine to transfer and to spot certain dimensions. It is surprising how a craftsman in this art can go confidently forward with only a comparatively few marks to aid him in developing a complicated design. That facileness of hand and sureness of eye, however, are the outgrowth of much practice.

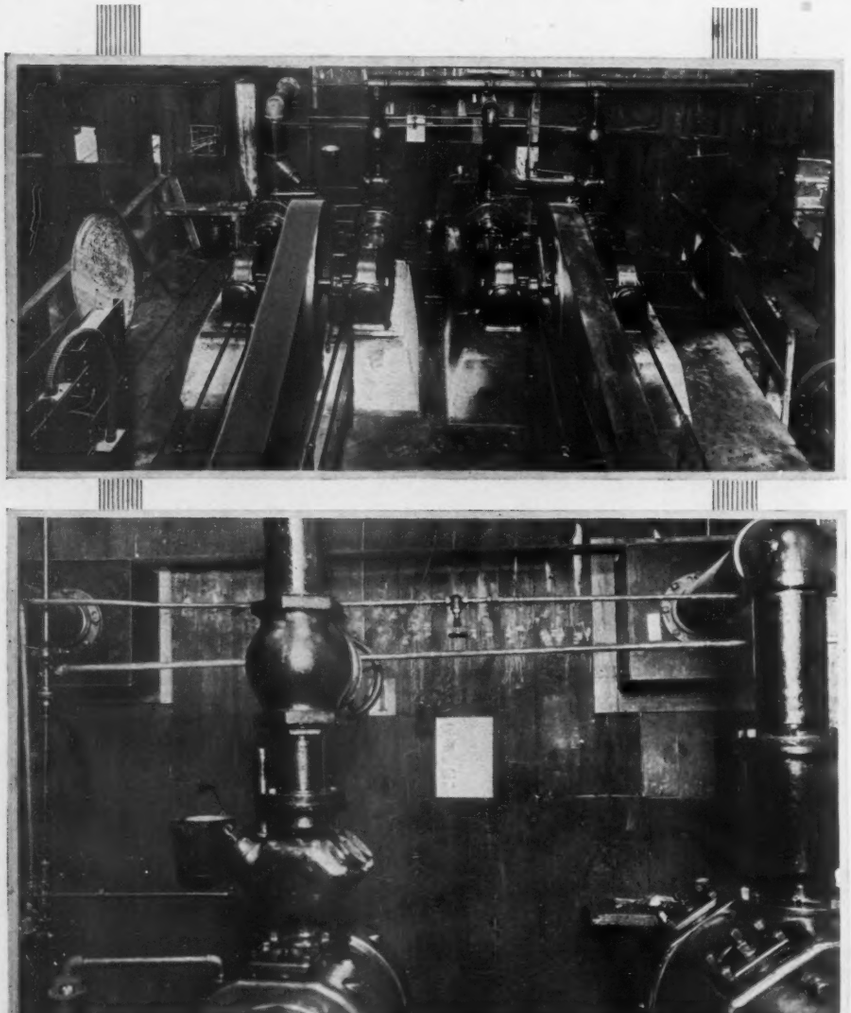
The modern stonecutter, in an establishment like that of William Bradley & Son, uses the time-honored chisel and mallet principally in roughing out a block when he detaches large chips of stone and works only to approximate dimensions. In developing details and in adhering nicely to prescribed measurements, he has recourse to air-operated tools of different sizes with which he is able to do his work with the utmost precision. These tools deliver to their cutting edges blows of varying force, and the trained artisan can thus carve the most delicate line or tracery in any kind of stone that lends itself to architectural purposes.

It goes without saying that care must be exercised at every turn during the cutting and the carving of much of the stone to protect the work from damage, and by damage we do not mean only breakage and disfigurement due to chance blows. A piece of stone may be

An electrically driven saw, equipped with carborundum teeth, cutting up a thick slab of marble.

1—Cutting Indiana limestone for an architectural exterior. 2—Putting the finishing touches on an elaborately cut piece of stone. 3—A block of marble that has been cut by gang saws into a nested succession of corner sections for interior use. 4—Carving a complicated "canopy" for the Cathedral of St. John the Divine. 5—Stone carvers working from plaster models and using compass pointing machines to transfer dimensions.

seriously injured by staining through oil or rusty water getting upon it; and here is where atmospheric conditions may occasion trouble in a stone-cutting establishment. Advantageous as the firm finds its location on the East River, nevertheless that stream and the nearby Atlantic Ocean and Long Island Sound have much to do with increasing the humidity of the air in the neighborhood at frequent and somewhat protracted periods the year round.



Top—Two of the three XRB Ingersoll-Rand compressors that furnish air in the stone-cutting plant of William Bradley & Son. Bottom—The installation of two Midwest air filters on Ingersoll-Rand compressors.

Naturally, the compressors providing operating air in the plant have to draw their air from the enveloping atmosphere; and that moisture was long a source of trouble and expense. The practice was to deliver the warm air from the compressors directly to receivers from which it was distributed to the various working stations—the air often being warm when it reached the pneumatic chisels or drills.

No matter what was the season of the year, there was always sufficient difference between the temperature of the air discharged from the pneumatic tools and that of the general atmosphere to cause condensation in the tools, and the moisture thus released would frost the tools, chill the hands of the operators, and not infrequently wash out the lubricating oil and spatter it over the work. By washing out the lubricant, the water increased the wear upon the tools, occasioned rapid deterioration of connecting hose, and materially lowered the general operating efficiency of the plant. The need of dry air becomes more apparent when we are reminded that William Bradley & Son use compressed air not only to operate cutting tools and plug drills, as well as an air lift, but also to clean all their electric motors, which have a combined installed capacity of 2,200 hp.

After investigation, the firm decided to provide its air plant, consisting of three XRB Ingersoll-Rand compressors, with an aftercooler of sufficient capacity to handle the output of the machines under maximum working conditions. The air now goes from the compressors to an aftercooler and from the aftercooler to a nearby receiver. There is also a second receiver at the far end of the air line, which distributes air at a service pressure of 80 pounds. This arrangement has effectually disposed of all troublesome moisture during the most humid seasons of the year, and has resulted in the avoidance of much trouble and expense. The tools perform better; no dirty water or oil is exhausted on to the work; and the hands of the men are no longer kept wet and benumbed by the frigid discharge. It would be hard to point to a more outstanding example of betterments made possible by air dried through the medium of an interposed aftercooler.

The firm has an operating force that ranges between 450 and 600 persons; and during 1929 the plant produced 300,000 cubic feet of cut stone for all sorts of architectural purposes. It is interesting to know that the plant obtains all the fresh water it needs from three deep wells drilled through solid rock. Two of these wells are 200 feet deep, while the third one is 275 feet deep. The water is raised by air lift to a sump from which centrifugal pumps deliver it to two supply tanks on the roof of the big cutting shed. The water so drawn from the ground costs considerably less than an equal supply would if it came from the municipal system, the mains of which traverse the street at the plant entrance.

AIR HAMMER AS VIBRATOR HELPS TO WITHDRAW PILING

WE have heard of compressed air being used to good effect to drive piles, but now we learn of an instance where it has been employed with equally good results to withdraw them after they have served their purpose. In widening the Concorde Bridge in Paris, France, a part of the embankment had to be removed to make room for the building of a masonry abutment. This necessitated the driving of sheet piling both to prevent soil movement and the infiltration of water.

With the abutment finished, the work of pulling out the piling was taken in hand, and this was done by means of a steam crane and a vibrator. The latter, according to *The Engineer*, consisted of a cylinder, freely suspended from a cable, containing a specially mounted air-operated hammer. At the lowermost end of the axis supporting the hammer were two plates and at the bottom of these was another axis carrying two more plates which were bolted to the unit to be withdrawn. The arrangement was such that while the cable exerted a tension on the pile the pneumatic hammer set up the necessary vibration to loosen the hold of the ground on the pile, which could then be easily extracted by the crane.

There has lately been devised an airplane landing skid that is housed in the fuselage when the craft is aloft so as to lessen wind resistance. The release of the skid, as well as its return to flying position, is effected through the medium of two powerful springs, encased within two pivoted cylinders, which are acted upon by pistons under the impulse of compressed air. The air also serves as a shock absorber upon alighting.

Compressed Air's Part in the Art of Lens-Making

Glimpse of an Important Department of the Plant of the Eastman Kodak Company

By A. M. HOFFMANN

Courtesy, Oil Power

Heating cubes of lens glass in a gas furnace preparatory to molding them into disks in the air-operated press at the right.

"SNAPPING pictures" is a pastime pursued with enthusiasm especially in the United States, and, if a census were taken, the homes without a kodak would probably be found to be few and far between. This interest in photography, however, usually does not go beyond the taking of the pictures, whereas the instrument, particularly the lens which makes this possible, is well worth considering. Whether the camera be little or big—a Brownie or one used to take airplane views, the lens is made with pretty much the same care and precision, for it is upon the lens that clearness of outline, definition, ultimately depends. In other words, the lens is the eye of the apparatus, and what the eye cannot see the film cannot record.

In the Hawk-Eye Works of the Eastman Kodak Company are produced lenses for more than 40 different kinds of cameras, and many of these lenses are ground and polished to within one thirty-thousandth of an inch of the true curvature of a test glass. In this work compressed air has numerous unrelated functions to perform—functions that range all the way from operating presses for molding lens blanks and semi-finished lenses to cleaning lenses before blocking, drying lacquered edges of lenses, and blowing lint from lenses and mounts during their assembly. But let us begin with a slab of raw optical glass, as it is delivered at the works, and see what is done to it during its progress through the plant.

Before starting on its journey, the slab is examined for folds and for fire cracks. If any of these are present they are ground out on a carborundum wheel. After the removal of the surface defects all four sides of the slab are ground. Milling machines, equipped with diamond-pointed saw disks, next cut the slab into strips and then into cubes, each of which contains just the right quantity of glass for the particular size of lens that is to be made. These cubes are individually tested before any further work is done on them. Those that pass the test are heated in a gas furnace to a temperature of 1,600°F. and, when the glass is sufficiently plastic, are dropped, one by one, into a die and molded into disks or blanks by the action of a pneumatic plunger. Air at a pressure of 60 pounds per square inch is used for this purpose.

The annealing process that follows is what might be called the critical step in the manufacture of lenses, because upon it largely depends the success of the finished product. If all internal stresses are not removed the glass disks may break while undergoing subsequent grinding operations, or they may have to be discarded eventually because they are incapable of refracting light uniformly.

The stresses in question are released by placing the disks, after they leave the molding machine, in an automatically controlled annealing oven where they are first subjected to a temperature of 1,000°F. and then cooled over a protracted period in order to prevent the setting up of new undesirable stresses—the entire process taking anywhere from 96 to 120 hours. At this stage the work is again examined. If the blanks show no internal stresses under a polariscope they are tested for defects that might have been caused during molding. This consists of putting them in a glass dish containing a liquid that has approximately the same refractive index as the disks, themselves. Those that meet the requirements are ready for grinding.

Lenses receiving their final smooth finish at the polishing bench.

In the grinding department the blanks must be handled with the same care that has been exercised from the moment the raw material or slab was scrutinized for defects by experts. The disks first undergo rough or preparatory grinding. This is accomplished by contact with a rotating cast-iron plate covered with a paste of coarse emery. Depending on whether the lenses are to be concave or convex, the blanks—in groups of as many as the curvature will allow—are now affixed with molten pitch to either the inner or the outer surface of a shallow bowl-like member which constitutes the upper part of the finished-grinding equipment. The lower part of the unit is coated with emery paste and fits into or around the lens-holding member, as the case may be. It is a sort of ball-and-socket arrangement, of cast iron, with both parts rubbing one against the other. In fact, the grinding action might be likened to that secured when one hand is clenched into a fist and the other hand is cupped and rubbed over and around it.

As the grinding proceeds, and the disks begin to assume the form of lenses, more closely fitting grinders take up the work and finer and finer grades of emery are successively employed until the desired curvature is obtained. But let it be

Top—Edges of lenses being blackened to reduce reflection. The lacquer used for this purpose is dried with a blast of compressed air. Bottom—Inspecting and cleaning department where compressed air serves to blow lint and dust from finished lenses.

understood that all lenses made at the Hawk-Eye Works are not machine ground. Certain of them for special purposes, of a size or of a kind for which there is not a sufficiently large demand to warrant the installation of the necessary machinery, are turned out by hand.

The lenses as they come from the grinding tables are smooth and semi-transparent, ready for polishing. This is done in much the same way as is the grinding, except that jeweler's rouge is used instead of the abrasive emery and that the polishing member is lined with felt or wax—the latter giving an exceptionally high finish. The lenses have now reached the point where they must pass the final tests which determine whether or not a lens is suitable for mounting. Any difference in curvature between a lens and the test glass is readily detected because it is visible in the form of what are known as Newton's rings—bands of color caused by interfering light rays. The greater the number of these rings the farther the lens is from perfection.

It is during the latter stages of lens-making, just preceding mounting, that compressed air is again needed, and this time it is used for cleaning and drying, as has already been mentioned in the beginning of this article. Much more of interest might be added concerning the subsequent operations, but our slab of optical glass has reached the end of its journey and we have finished the story we set out to tell—the story of why, with even the cheapest of the many types of cameras produced by the Eastman Kodak Company, it is possible to take pictures that are astonishingly clear in detail.

Assembling lenses, mounts, and shutters at the Hawk-Eye Works of the Eastman Kodak Company.

SIPHONS RELOCATED WITH AID OF DIVERS

LOWERING two 30-inch cast-iron submarine siphons, part of a water-supply system, from Elevation −32 to −38.5 in the Hackensack River while at the same time keeping the fairway open to shipping has been no small task. The work has been successfully accomplished, and had to be done before United States Army engineers could deepen the channel of that stream, as authorized by the Government.

Throughout most of the span of 1,800 feet the mains were readily lowered into the trenches, dug for them with a hydraulic dredge, by the aid of 27 winches placed on trestle bents reaching above water level. But when it came to the 400-foot fairway, obstructions that would interfere with navigation were not permissible. There the working platforms consisted of pile bents spaced 24 feet apart on the river bottom—the siphons being suspended from the bents by means of slings and threaded rods.

One siphon was handled at a time: the contractor making his way across the river and then back again. At signals by the man in charge of operations, workmen, stationed at the winches, gave them a fixed number of turns—thus step by step and at a predetermined rate lowering that part of the main extending from the shore to the channel. In the meanwhile three divers were engaged in lowering the 400-foot channel section. This was done in 6-inch stages, the divers turning the bearing nuts on three adjoining rods and moving on from group to group and back again until the siphon rested on the bottom of the trench, or 6.5 feet below its former level. It took just twelve hours for the divers to accomplish this.

Flexible ball joints between the 8-foot lengths forming the Hackensack River crossing of the Bayonne, N. J., water-supply system proved of considerable aid, as they permitted a deflection of 13° without leakage. However, by the methods employed, a maximum deflection of 8° was sufficient at all times. With both siphons in position, the joints were given a preliminary calking by divers using air-operated tools—subsequent tests showing a leakage of 2 cubic feet per minute under a working pressure of 60 pounds. Following that they were again calked and subjected to a pressure of 150 pounds to make sure that all the joints were tight.

Work has been started on the $50,000,000 terminal project of the Canadian National Railways at Montreal. The plans call for the expenditure of $10,000,000 annually for the next five years in the construction of the terminal which, it is expected, will be second only to the Grand Central Station in New York City. The undertaking involves the laying of 80 miles of new track; the excavating of 4,000,000 cubic yards of material; and the use of approximately 56,000 tons of structural steel and 350,000 barrels of cement.

Quarrying Rock Asphalt in Texas

Early History and Present-Day Uses of This Product Mixed in Nature's Laboratory

Section of the open pit showing quarrying operations.

By C. H. VIVIAN

MOST of us know that the black asphaltic top coat so widely used on pavements in cities is prepared by mixing crushed rock and asphalt in the proper proportions. We are all enough acquainted with asphalt to know that it is a member of that large family, the hydrocarbons. Our general reading has informed us of the amazing lake of asphalt on the Island of Trinidad, and we are also aware that asphalt is the base of much of the world's petroleum, from which it is secured commercially by refining processes.

Comparatively few of us, however, are familiar with the fact that at several points on the globe there are areas where Nature has set up her own mixing plants and brought together rock and asphalt in such proportions that it is only necessary to mine and to crush the material before laying it down and compressing it into serviceable, durable road and street surfaces.

Such natural rock-asphalt deposits have been worked in Europe for several centuries. In the United States, commercial deposits of this kind occur in Texas and Kentucky. Those in Texas are the more important, and are being utilized to a greater extent. Pavements and roads built of this material compare very favorably with those of artificially prepared mixtures. Indeed, the two are essentially the same product. The use of natural rock asphalt has been confined to sections relatively close to the deposits because the material is expensive to ship great distances. Since the larger portion of it is rock, there is an economic limit beyond which it is cheaper to ship in only the asphalt and mix it at the point of use with stone secured from a local source.

Although asphalt has been employed extensively as a roadbuilding material in recent years, its application in that field dates back less than a full century. Asphalt itself, however, is not a newly discovered material. It was well known to the ancients, and has been used down through the ages for a variety of purposes. Babylonian builders utilized asphalt to waterproof the foundations of their houses, to line the moat that surrounded their city, as a mortar, and in other ways. It was the principal constituent of the embalming fluid that so well preserved human bodies in mummified form. Much of the asphalt supply of those early users came from the Dead Sea. Large masses of it, apparently having exuded from crevices in the bottom, rose to the surface of the water, from where it was gathered with the aid of boats.

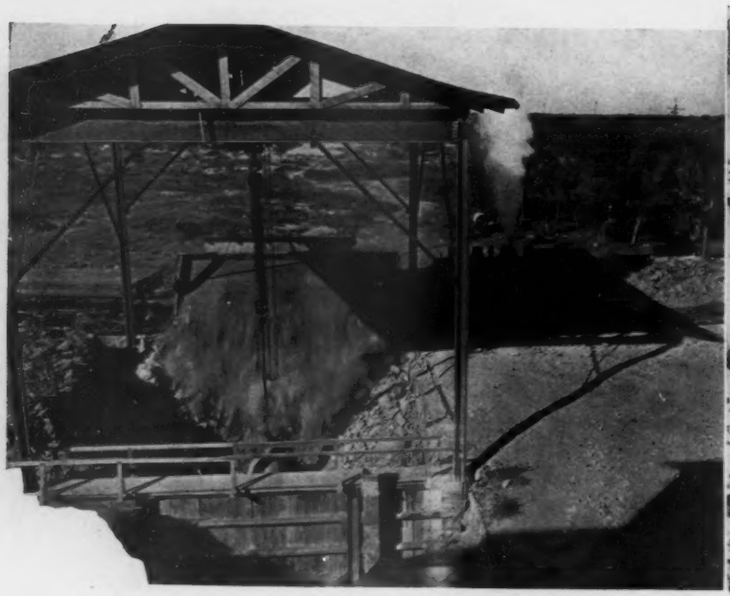
© Carl D. Newton

One of the skid-mounted X-71 drifter drills putting down 21-foot holes in difficult material.

The Romans used an asphaltic coating to protect their household goods from decay. With them and other peoples it found great favor as a medicine. It was considered an excellent preventive for boils, gout, blindness, toothache, colic, and other ailments and afflictions. The women colored their eyebrows with it and used a perfume that was made from it. Asphalt is mentioned in several places in the Bible, and it is interesting to note that Noah gave the ark two exterior coats and one interior coat of bitumen to make it watertight.

Europe has a number of natural rock-asphalt deposits, the best known of which are at Seyssel, France, and Val de Travers, Switzerland. These were an important source of asphalt before the present commercial methods of obtaining the substance were known. It was extracted from the rock by heating, or by the use of spirits; and the product obtained was called mastic.

It was at Val de Travers that an engineer made the discovery, a little more than 100 years ago, that rock asphalt was an excellent road-surfacing material. That engineer was impressed by the fact that the road leading from the rock-asphalt quarry to the mastic factory never became muddy in wet weather nor dusty in dry weather. In seeking an



Left—A carload of rock asphalt caught at the moment of dumping into the primary crusher.

Right—The 42-inch gyratory crusher which has a capacity of 6,000 tons every 24 hours.

explanation therefor, he observed that the springless carts used for hauling jostled some of the rock out upon the roadway, where it was crushed and compacted by their metal-tired wheels. That engineer had been attempting to construct roads of asphalt rock, but had been unsuccessful because he had omitted one very important requisite—the application of pressure. Once his observation of the road from the quarry had taught him this secret, he rolled the stone after spreading it upon the ground and succeeded in building a very satisfactory highway.

Rock asphalt was introduced in Paris in 1838 as a material for building sidewalks, but its use for this purpose did not become general until some twenty years later. The next step was, naturally, the adoption of rock asphalt for street paving. It was employed in this manner in London in 1869, and in Berlin in 1873. The first asphaltic pavement laid in the United States was put down in 1870, in Newark, N. J., by E. J. de Smedt.

From the foregoing facts it can be seen that natural rock asphalt was the forerunner of the prepared asphaltic street-surfacing material with which we are more familiar in the United States today. Europe has used the natural rock to a great extent because the material was readily available, and some of it has, in times past, been shipped to the United States. In this country, however, the trend was, from the outset, toward the prepared material. This was true because we then knew of no local natural deposits and, later, when some were discovered, it was too expensive to ship the stone from Texas or Kentucky over the country as a whole.

In the light of the present widespread use of asphalt paving, it is interesting to recall that there was much opposition to it when it was introduced. When the first asphalt-surfaced roads were proposed in England, the people objected on the score that black streaks across the landscape would mar the natural beauty of the countryside. Engineers pointed out to them that, after the free bitumen had worn off the surface, the prevailing color would not be black but gray—the lightness or darkness of which would be governed by the color of the rock aggregate mixed with the rock asphalt.

In the United States, asphalt pavements were assailed on the ground that they were slippery. This was, of course, in the days when horse-drawn traffic predominated. To establish their product in the face of such criticism, the asphalt interests caused an investigation to be made in ten American cities. The data secured during several months of observation led to the publication of the statement that horses fell more frequently on wood and on granite pavements than they did on asphalt ones. It was declared that, on an average, a horse would travel 583 miles on asphalt without an accident, as compared to 413 miles on granite, and 272 miles on wood blocks. It was also asserted that a horse could draw a heavier load over asphalt than over any other type of pavement then in use.

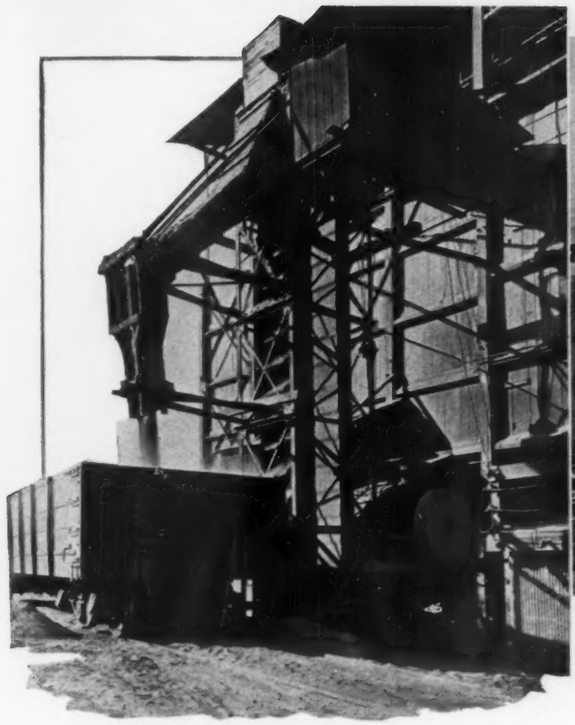
Asphalt is formed from the decomposition of organic matter, the theory being that petroleum or some similar product is first formed and that the lighter oils are subsequently driven off by natural destructive distillation —leaving the heavy residue of asphalt. Two series of hydrocarbons are contained in asphalt, the proportion of each varying according to the source of the product. To the constituent which gives asphalt its viscousness and its adhesive qualities chemists have given the name petrolene. The other constituent, called asphaltene, imparts hardness, which is an essential quality in paving. It is generally considered that asphalt containing approximately 30 per cent asphaltene and 70 per cent petrolene makes a satisfactory pavement.

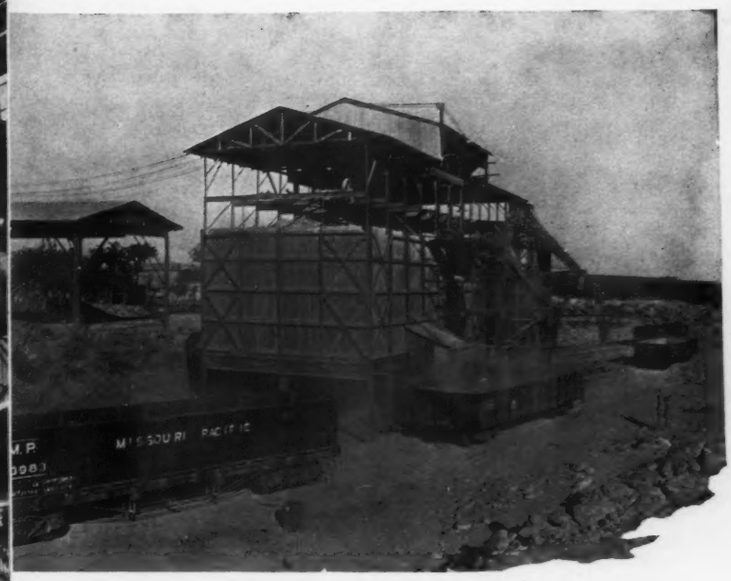
The most important rock-asphalt deposits in Texas are in Uvalde County, about 110 miles from San Antonio. They lie close to the surface, in a broad synclinorium or saucer-shaped structure of sedimentary rock, in close association with masses of igneous rock whose intrusion probably furnished the heat that drove off the more volatile components of the original petroleum deposit and left the heavy asphalt. At some stage in the geologic process, pressure—imparted by folding of the strata or by other means—forced the asphalt into one stratum of the horizontally disposed sedimentary series, impregnating the rock so that it is now a mottled gray, the spots representing free asphalt.

The rock aggregate of the Uvalde deposits is limestone, which well meets the requirements of a roadbuilding material. In this respect, it is similar to the better known European product. The Kentucky rock asphalt, on the other hand, is an impregnated sandstone.

The Uvalde deposits were opened up in 1894, and the first shipments were of "lithocarbon," which consisted of bitumen extracted from the rock by treatment with naphtha. This product was of two classes—a hard gum, known as mastic, and a soft gum which was not entirely free of naphtha. In 1895, shipments totaled 450 tons, which sold for $50 a ton in New York. Following a 4-year period of inactivity, 825 tons were shipped in 1899, and 260 tons in 1900. Since the last-mentioned year, the bitumen has not been extracted, and the rock asphalt has been sold both in the crude form and pulverized.

In San Antonio and in other Texas cities there are pavements constructed from Uvalde





Left—Loading a car of pulverized rock asphalt for shipment.

Right—General view of the crushing plant showing loading facilities.

rock asphalt that are still in good condition after more than 25 years of service. The material has been used in large quantities in recent years for both highways and streets. In Bexar County, Texas, alone, there are more than 500 miles of roads paved with it.

One of the principal operating companies in the Uvalde area is White's Uvalde Mines. This company, which is owned by R. L. White of San Antonio, controls the mineral rights of some 30,000 acres of land there. It has been producing rock asphalt since 1924. Its present center of activity is known as Mine No. 4, which was opened up about three years ago. The deposit being mined has been determined, by exploratory drilling, to be approximately 4,000 feet long, 1,000 feet wide, and from 65 to 85 feet thick. The operations consist of mining the rock and crushing it for shipment. The deposit is being worked from one end, and the crushing plant is established at the other end. This permits advancing progressively toward the crushing plant and disposing of the waste and overburden behind the operations at all times.

The soil overburden is from 2 to 4 feet thick. This is stripped away with a Bucyrus-Erie, Class 14 dragline equipped with a 100-foot boom and a 2-cubic-yard bucket. Once the overlying mantle is removed, extraction of the rock asphalt is carried on by the bench method of quarrying. Three cuts, of approximately 21 feet each, suffice to reach the bottom of the deposit at the point of present operations. The rock consists of about 10 to 12 per cent asphalt and of 88 to 90 per cent limestone. These proportions make a very satisfactory roadbuilding material, so it can be seen that the natural forces which created the deposit worked in full accord with the prospective needs of man.

It goes without saying that the asphalt content of the rock complicates the drilling problem. It gums on the bit, and tends to plug the drill hole and to stall the drill rotation. "Jackhamers" were at first employed for all drilling. About two years ago it was decided to try mounted drills, and the X-71 type of drifter was selected as best suited for the purpose. The result was a remarkable gain in efficiency. The average footage made per drill per day was increased from 80 to 420. Because drifter drills use steels with larger bits it is possible to load the holes with more powder; and holes are now staggered on 6-foot centers, as compared to 4-foot centers when "Jackhamers" were utilized. Two skid-mounted X-71 drills do all the primary drilling. In putting down a 21-foot hole three changes of steel are made—the sequence being 8-, 16-, and 22-foot lengths. The gages of the bits on these are, respectively, 2, 1⅞, and 1¾ inches.

The X-71 is a wet drill. To overcome the tendency of the asphalt in the drill cuttings to plug the water passage in the steel, the normal opening in the center of the bit is forged up solid. A hole is then drilled from the side of the bit to meet the central passage. This hole is placed in one of the grooves between the wings of the bit and about 3 inches above the cutting face. This type of steel has been successful in maintaining an uninterrupted flow of water to wash away the cuttings.

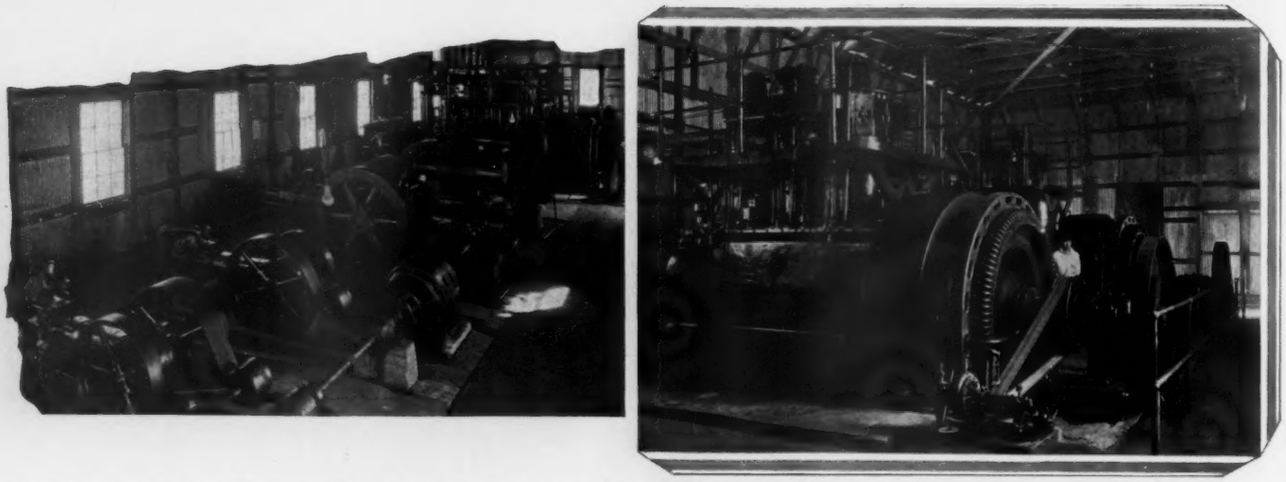
Blasting is done with 60 per cent dynamite in sticks of 8x1½ inches. Three rows of holes are generally shot at a time. The charge is balanced—eighteen sticks being ordinarily used in the back row of holes and from eight to twelve sticks in the front and intermediate rows. About ½ pound of explosive is required per ton of rock taken out. Large boulders brought down are block-holed with BCR-430 and BAR-33 "Jackhamers" to facilitate handling. Mexican labor is employed almost exclusively on the drills.

A standard-gage railroad, about three-quarters of a mile long, connects the quarry with the crushing plant. Side-dump cars of 16 cubic yards capacity do the hauling. Two steam locomotives, one of 33 tons and one of 28 tons, alternate in this service. Two Bucyrus-Erie power shovels, carrying 2-cubic-yard dippers, are used for loading.

At the crushing plant the cars are dumped by means of an air-operated jack into an Allis-Chalmers 42-inch gyratory crusher, which has a capacity of 6,000 tons per 24 hours. The crusher is driven by Texropes from a 150-hp. motor. The crushed material is elevated into a bin which has a capacity of approximately 3,000 tons. This rock is either shipped as is and further reduced in size at the points where it is laid, or it is pulverized at the plant. Two pulverizers are provided for this purpose—a Williams Jumbo, which is direct driven by a 200-hp. motor, and a Williams Junior which is driven through a flexible coupling by a 150-hp. motor.

In laying the asphalt it is desirable to mix with it a small amount of asphaltic base oil which serves as a binding agent. Large contractors have their own mixers, but there are many small contractors who desire to secure a pre-mixed material that is ready for use when delivered to the job. To meet this demand, the company maintains a mixing plant at one end of the storage bin. The oil used contains not less than 50 per cent asphalt. One ton of rock asphalt will lay 20 square yards of pavement 1 inch thick.

All the electricity and compressed air used at the mine and the crushing plant are produced with oil-engine-driven units—the total installed horsepower in oil engines being 935.



Left—Power plant at White's Uvalde Mines housing, from left to right, two Class ER-1 compressors, two Type POC-2 oil-engine-driven compressors, and two oil-engine generating units. This room also contains a 35-kw. oil-engine generator which supplies current for lighting. Right—Close-up of the two 330-hp. PR oil engines direct connected to 220-kw. generators which produce the electric power used on the property.

There are two Ingersoll-Rand Type PR, 330-hp., solid-injection engines, each of 3 cylinders, 17¾x22 inches. Each is direct connected to a 220-kw. generator. The current generated is of 2,300 volts, 3 phase, and 60 cycles. This energy supplies the dragline and the electric shovel at the mine, the various motors at the crushing plant, and one motor for driving two auxiliary compressors in the power plant. The mine and the crushing plant are operated only one shift, and the generator units are shut down at night. To supply power for lights and other purposes, there is a PO, 55-hp. oil engine that drives a 35-kw. generator.

Compressed air is furnished by two Ingersoll-Rand Type POC-2, 110-hp., oil-engine-driven compressors, each of 603 cubic feet per minute piston displacement. There are two spare compressors, either or both of which can be belted to a common line shafting that is driven from a motor. These are Class ER-1 machines, each of which has a piston displacement of 368 cubic feet per minute. All these oil engines have operated practically without trouble since they were installed in March, 1926; and the annual repair bill on them is negligible.

A closed cooling-water system, with a tower for cooling the water before re-use, is provided. The source of the water is the pit of an abandoned mine, some distance away, from which it is pumped. By treating the water in a Duro softener, the content of solid material is greatly reduced, and very little scale forms in the engine cylinder jackets. It has been necessary to replace only one cylinder head on the engines since they were installed.

It is noteworthy that while there is a connected load of nearly 900 hp. in motors at the mine and the crushing plant, the work is conducted in such a manner that the 660 hp. in oil-engine generators takes care of the demands with very infrequent overloading. The load required for most of the operations is intermittent, and the various phases of the work are so timed that the 900 hp. of connected load is never needed at any one time. For example, while the gyratory crusher is in operation the electric shovel at the mine is idle, awaiting the return of the train of dump cars. By the time loading starts again at the mine the crusher has completed its work.

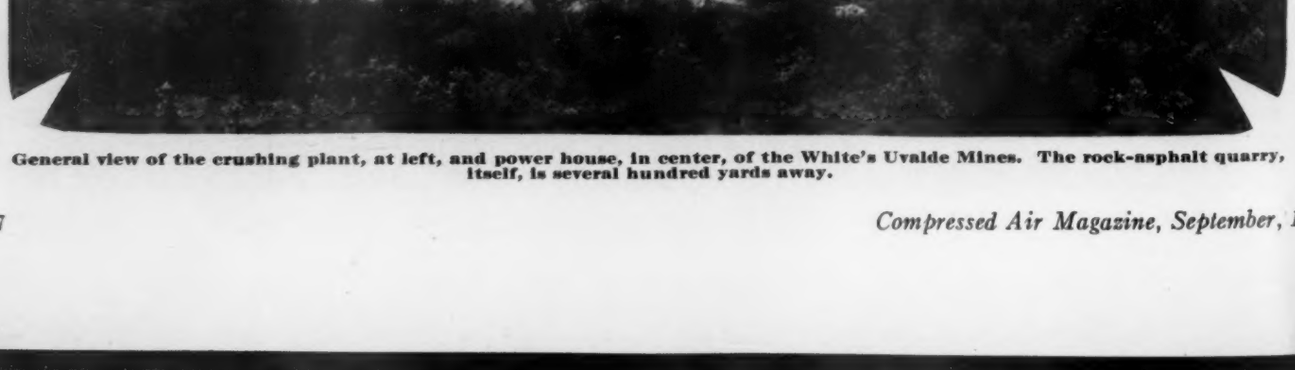
Drill-steel sharpening equipment consists of two Ingersoll-Rand sharpeners, a No. 33 and a No. 50, and of a No. 25 oil furnace. A pneumatic paving breaker has been ingeniously mounted on a frame above an anvil to form a hammer for light forging work.

Most of the material produced by White's Uvalde Mines is used in Texas and adjoining states. Frank Coughlin has served as general superintendent of the property since the present operations were started.

NEW COMPOUND FOR TINNING METALS

A CANADIAN, so it is reported, has discovered a new compound for tinning metals—a compound that, according to all accounts, promises to be of value especially in the manufacture of bearings for heavy machinery. It is in the form of a powder composed of pure tin and a flux, the nature of which has not been divulged. The powder is merely sprinkled over the metal after it has been heated.

Any metal except aluminum, it is claimed, can in this fashion be given a coating of tin without first cleaning the surfaces. The substance frees the metal of any dirt, and it actually forms an alloy having considerable interpenetration. In the case of cast iron, for example, it can be tinned even though it be rusty. Because of these characteristics, several engine manufacturers using white-metal bearings in cast-iron shells have already taken advantage of this method of tinning, which also enables them to solder the white metal to the shell. The firm bond thus assured and the ease of application are factors that should appeal to makers of Diesel engines, air compressors, and other machinery in which the bearings are subject to heavy pressure.



General view of the crushing plant, at left, and power house, in center, of the White's Uvalde Mines. The rock-asphalt quarry, itself, is several hundred yards away.

Stanley zigzag and folding rules are known the world over because of their excellence.

From Bolts to Zigzag Rules

Evolution of a New Britain Concern That Has Been Making Hardware and Tools for Widely Differing Uses for Nearly Ninety Years

By R. U. SQUARE

Z-I-P! It is open. Z-I-P! It is closed. That is exactly what happens when expert inspectors manipulate zigzag rules before those handy measuring aids are packed ready for shipping from The Stanley Rule & Level Plant, at New Britain, Conn. Back of what trained and nimble fingers do with a zigzag rule is the history of a great and manysided concern that produces tools and diversified hardware for a multiplicity of services and purposes.

The Stanley Works, as the New Britain plant is commonly known, has an industrial background of nearly 90 years; and it is the outgrowth of a business built up on bolts first made in the early "forties" by Frederick T. Stanley. Mr. Stanley not only fashioned his bolts by hand—thus knowing that they were all that he represented them to be, but he drove through the surrounding countryside selling his products to rural dwellers, often doing the work of securing them to barn doors and to farmhouses needing that attention. In short, he produced his bolts and furnished personal service, as well. As has been said: "The business grew not merely because the product was good, but because of the sincerity of the man who made and marketed it".

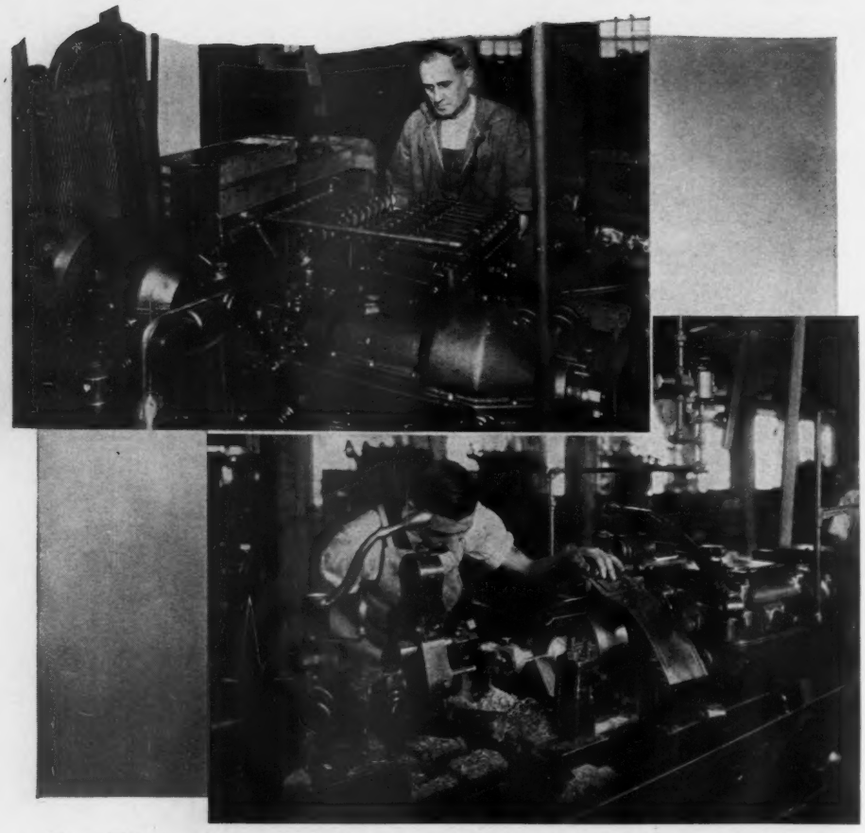
Along about 1852, after proving what he could do in his little shop in turning out a worth-while and much-needed commodity, a number of his fellow villagers pooled their savings with his, and thus $30,000 was made available to warrant the incorporation of The Stanley Works. That was a momentous occasion in the annals of New Britain. The working force was augmented to a total of 25 men; and butts and hinges were added to the established bolt business. Those three articles laid the foundation of a determined movement on the part of the incorporators to supply the trade with better hardware; and as a means to that end The Stanley Works led the way in devising processes for the making of cold-rolled steel and for the forming of it into the products in which the organization specialized. That was a revolutionary departure, and an advance in the art that occasioned wonderment for a goodly while.

In the years that have intervened since The Stanley Works was incorporated, the products have increased in number and the field of service has been amplified accordingly. Having entered into the making of an essential basic material—cold-rolled steel, it is easily understandable how The Stanley Works gradually added to the commodities first manufactured by it. Bolts, butts, and hinges were followed by a succession of hardware specialties; and these, in their turn, were followed by carpenter's tools that have become today so diversified that they meet all that craftsman's requirements. Indeed, each and all of us can find uses for several of the products of this company's varied line.

The Stanley Rule & Level Plant—now a division of The Stanley Works—had its beginning back in 1850; and, as the name indicates, it was originally organized to manufacture boxwood and ivory rules. A few years later, The Stanley Rule & Level Company, as it was known for a long while, absorbed several other young companies and took up the making of levels, plumbs, and tool handles. Along about 1870, the Stanley enterprise settled upon the policy of concentrating on the production of tools for carpenters and mechanics; and this course has been adhered to in the main ever since. One has but to look over the contents of either a carpenter's or a mechanic's tool box to realize that these are sufficiently numerous and varied to satisfy the productive desires of any concern wishing to have a diversified line.

In the course of its growth and the widening of its field, the company has purchased plants here and there throughout the country; and each of these acquisitions has usually had an established reputation for its particular product or products. This was equally true of The Eagle Square Manufacturing Company, of South Shaftsbury, Vt., which is operated today as a branch plant. That concern was founded as far back as 1817; and today it is reputed to be the largest producer of carpenters' steel squares in the country. As a part of those shops there is a woodworking department that utilizes hardwoods native to the neighborhood, and these are fashioned into handles, mallets, and zigzag rules. The last item brings us to the subject that first attracted us to this far-flung organization, which has attained to its present size through a noteworthy stability of growth.

Zigzag rules are familiar to most of us; and it occurred to us some months ago that many of our readers would like to know how such rules are made. With this thought in mind, we approached The Stanley Works at New Britain. The officials were sympathetic and gracious, and while they were quite willing that we visit the rule department they were reluctant to have us describe in any detail



Top—This machine, equipped with an air-operated clutch, is graduating the steel blades of squares with diamond-pointed tools.
Bottom—Compressed air operates a chuck and blows away chips on this machine, which is doing work on the spindle hub of a hand grinder.

the means and the methods employed in manufacturing their zigzag rules, which are sold the world over and enjoy an enviable reputation. Their polite opposition to publicity became understandable before our visit ended; and it revealed the reason for that characteristic New England industrial conservatism—a fine quality and a logical consequence of circumstances and environment.

The zigzag rule might properly be dubbed the long-legged relative of the familiar 2-foot folding rule. The zigzag rule is so contrived that it can be folded snugly upon itself and be then compact enough to tuck away conveniently in a handy pocket. Conversely, when elongated to its full length of 6 feet, it forms a sufficiently rigid measuring stick because of the ingenious way in which the associate sections are held together by a succession of spring joints.

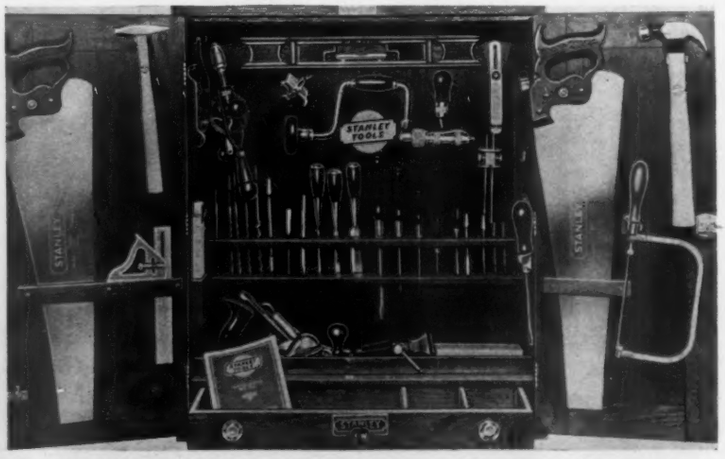
Like so many other things that we use frequently and for which we pay only a modest price, the zigzag rule is accepted as a matter of course. Even so, it is the result of years of manufacturing experience combined with the exercise of a good deal of ingenuity. Not only that, but the rules turned out in The Stanley Works are the uniform and the excellent products that they are mainly because of the machines and the methods utilized in their making. The methods are the outcome of decades of progress; and the machines employed are the result of much laboratory research—some of the apparatus being rather costly. All of them have been designed and fabricated to do well and repeatedly some particular and necessary phase of the work. Many thousands of dollars have been spent in learning how to manufacture zigzag rules efficiently and economically and of uniform quality.

Zigzag rules are not as simple in their making as they may seem to be in their subsequent handling and in what they do for the persons using them. Care has to be exercised at every stage of production—nothing is taken for granted even though a considerable measure of the work is done by machinery. The first stage of supervision has to do with the basic raw material from which are fashioned the thin and narrow wooden strips that form the unit sections of a rule. The wood is of a prescribed kind, and it has to meet very definite specifications. These strips are formed by saws, planers, and grinders, and each must be free of any defect that would be likely to weaken it or to make it unsuited for the part it has to play in the finished rule. Of course, the lumber used is properly seasoned.

After the strips have been fashioned and have been passed by keen-eyed inspectors, they are painted. This work is done by machinery, developed for the purpose, and is also dried by mechanical means that insure uniform results and the completion of the operation within a fixed period of time. Many thousands of these strips are coated in the course of a working day. The painted and dried strips are again inspected, the imperfect ones are rejected, and the satisfactory ones are run rapidly and successively through printing machines that stamp the strips with the graduations and the numerals marking the inches. There is a very noticeable difference between the clearness of the printing on a Stanley zigzag rule and the corresponding marks on those not measuring up to the same standard. The marking must be deep enough to insure its legibility after a considerable period of service involving much handling. The nature of the paint used is a factor in this desired durability.

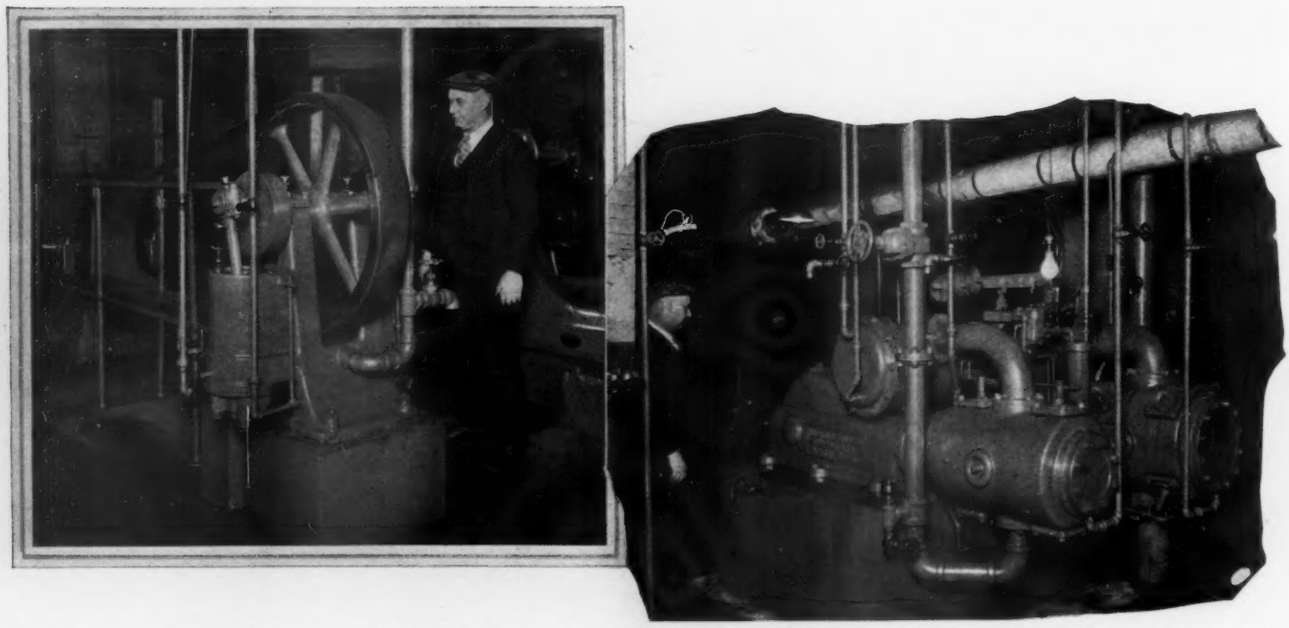
A glance at a zigzag rule will reveal that each unit section has its distinctive marking and that the numerals are different on the opposite sides. That is to say, a 6-foot rule is made up of twelve separate sections, and the first section, for instance, bears the numerals 1, 2, 3, 4, 5, and 6 on one side and 66, 67, 68, 69, 70, and 71 on the other side. This arrangement permits one to read feet and inches readily in either direction. As each section has its prescribed place in an assembled rule, all the strips for a given section are kept together in order to facilitate the rapid assembling of hundreds and thousands of zigzag rules and to avoid confusion the while.

Before the strips are ready for the forming of a complete rule, each strip receives a stamped metal clip which forms half of the pivoted hinge that holds each joint together. The clips are really male-and-female members that slip into each other snugly with a spring action when the rule is either elongated or folded. An ingeniously devised rivet, with an associate spring, is the medium that serves to complete the union. The fixing of the metal



Tool chest equipped to satisfy either a craftsman or the householder who takes pleasure in doing many things about the home.

1—Spray-painting a Stanley tool box. 2—This trained inspector handles zigzag rules with a sleight of hand that makes it possible for her to examine large numbers of them rapidly. 3—Spray-painting a group of Bailey metal plane bottoms. 4—Air-operated riveting machines in the zigzag rule department of The Stanley Rule & Level Plant.



Left—This compressor, built about 40 years ago by the Rand Drill Company, still furnishes air on occasions in The Stanley Rule & Level Plant at New Britain, Conn. Right—Primary source of much of the air used in The Stanley Rule & Level Plant. This machine is an Ingersoll-Rand Type XRB compressor.

clips to the strips and the final securing of the rivets are done with machines designed and built especially for the purpose; and nimble-fingered girls preside over these machines and perform their several repetitive operations with astonishing quickness. Compressed air is used in connection with the riveting machine; and it also serves to do other essential labor-saving work.

When the zigzag rules have received their finishing touches, then they are passed on to inspectors who speedily discover any shortcomings or structural defects. A wide sweep of the arms expertly opens a rule with apparently a single motion, and a reverse movement closes a rule with equal rapidity. Simple as it seems, that maneuver is a skillful one born of much practice; and it would be unwise for the untrained person to try it unless he wished to risk the breaking of his rule. When ready for packing, a zigzag rule represents a series of operations much more numerous than we have described; and it typifies the climax of much Yankee inventiveness and engineering cunning. These have helped the company to hold its own against all competitors; and we don't wonder a bit that it keeps its processes and machines to a large extent secret. The purchasing public loses nothing by this policy, because it gets the best thing of its kind that can be produced for the price asked.

In assembling the driving wheels of locomotives it is usually the practice to press the crank pins in position. However, something different has been tried recently by the Spokane, Portland & Seattle Railroad at its Vancouver, Wash., shop where an 8-inch crank pin was chilled and shrunk with liquid air preparatory to placing it in the main driving wheel of a Pacific type locomotive.

IMPROVED TIE TAMPER

THE accompanying illustration shows the new MT2 air-operated tie tamper designed by the Ingersoll-Rand Company and recently put on the market by that well-known concern. Among the features that distinguish this tie tamper from the model that preceded it is that of over-all length. Despite the fact that it carries a longer steel it is actually 3 inches shorter than the MT1. The net result of this is a slight reduction in weight and a marked increase in clearance, making for ease of handling and ease of operating, especially when tamping in confined areas around frogs and switches.

Model MT2 tie tamper equipped with a removable crossbar handle and showing other improvements in design.

Another difference is to be found in the handle. This is so arranged that a crossbar grip can be inserted through the bottom of the spade handle with which the MT2 is equipped. The crossbar, consisting of two rubber-covered grips, is held in place by a long bolt.

Still other changes in design are: Position of air throttle, which is built into the front of the shaft where it is within convenient reach of the operator's hand; provision for two hose connections so that air can be delivered to the tool from either side—the change from one to the other being made quickly and easily; and a method of air exhaust that is such as to prevent freezing when tamping in cold weather.

INSULATING MATERIAL FROM SLAG

UNDER the name "Reforme" the French have put on the market a mineral wool that is said to possess high insulating qualities. The basic material is slag which, upon issuing from the blast furnace, is fragmented by a jet of compressed air and then delivered to a refractory-lined vessel where it is kept in a molten state. The necessary heat is supplied by oil burners. The bottom of the vessel is perforated—the slag passing thence in the form of fine threads on to a rotating cylinder. This drum is sprayed with cooling water to prevent the filaments from sticking together. The material resists temperatures, so it is claimed, up to 2,732° F.; has a density of 0.22; and has a coefficient of conductibility of 0.05 to 0.06 for temperatures ranging from 392 to 572° F.

Southern facade of the Grand Central Terminal, seen from the vehicular ramp at 42nd Street, New York City.

Large Excavations in Rock Made Under Difficult Conditions

Novel Means Employed in Completing the Lower-Level Loop at the Grand Central Terminal in New York City

By R. C. SKERRETT

THROUGH the gates of the Grand Central Terminal a tide of traffic ebbs and flows daily as thousands of persons enter or leave New York City. And among those that make up this fluctuating movement of humankind how many, we wonder, are aware of what that station represents in the way of coördinated efforts and facilities designed to contribute to the comfort and the convenience of the traveling multitude?

The Grand Central Terminal accommodates trains running in and out of Manhattan operated by the New York Central Lines and by the New York, New Haven & Hartford Railroad. The terminal was opened for service less than a score of years ago. At that time it was deemed commodious enough and complete enough in its facilities to meet the potential needs of traffic for half a century thereafter. Despite this expectation, travel has so increased within the last ten years that the New York Central Lines have found it necessary to make a number of alterations and betterments in order to take proper care of the continually swelling volume of business. Some of these changes have taxed the ingenuity of the engineering force of the system; but in each instance a successful solution of the problem has been found. The commuter or the long-distance traveler has generally been quite unaware of the prosecution of this important work—his immediate concern has been to arrive or to depart on time, and he has either hastened to his seat heedless of conditions about him or he has been equally impatient to leave his train and to reach his office or other destination somewhere in the surrounding municipality.

Main concourse of the Grand Central Terminal. Approximately 75,000,000 persons use the terminal during a year.

In modifying and in amplifying the facilities bearing directly upon the handling and the accommodating of inbound and outbound trains, the engineers responsible for the operation of the Grand Central Terminal have had to be mindful of that very traveling public that commonly treats their efforts casually. These qualified experts have had to devise ways and means so that the essential work could be pushed forward rapidly and safely. Speed and safety are not, in themselves, factors in a job that are easily combined. This is notably true where thousands of cubic yards of rock have

to be excavated near vitally important switching apparatus and close to tracks on which crowded trains are run at more or less frequent intervals. And yet just this thing has been done and is being done below street level in the Grand Central Terminal; and radical betterments are being carried out beneath towering buildings without imperiling the foundations and the underpinnings of those structures.

Looking down one of the twenty 36-inch holes, 22 feet deep, sunk with a Class WS "Calyx" drill.

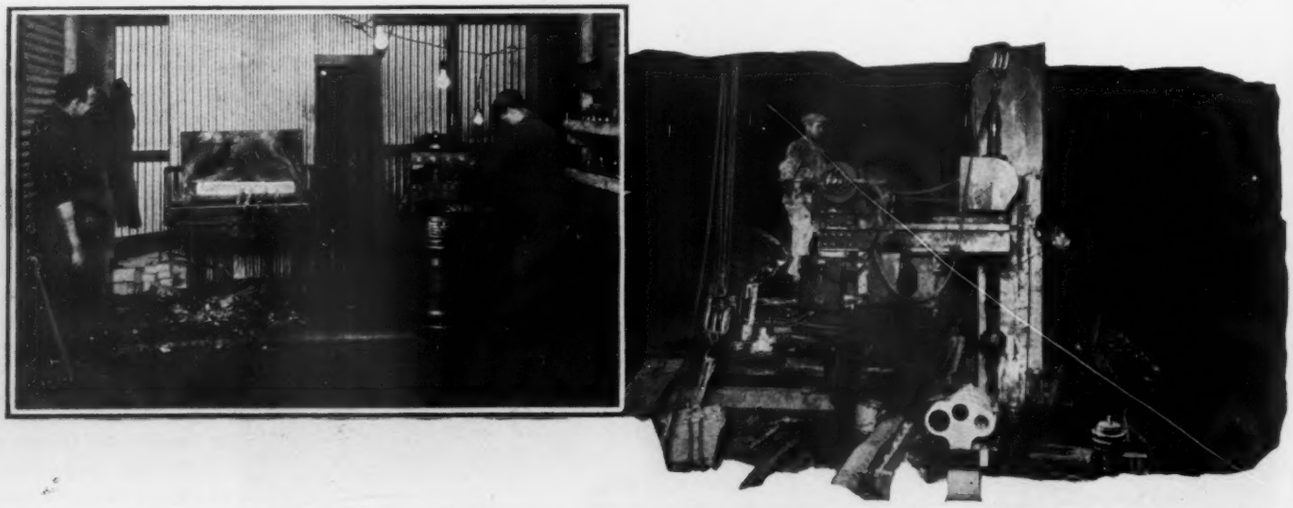
It would be of wide interest if the story of what the engineering department has done latterly at the Grand Central Terminal could be told in its completeness; but space forbids at present. Instead, we shall describe briefly a single undertaking that will contribute measurably to the ease with which suburban trains, especially, can be handled, thereby increasing the number of them using the terminal every 24 hours, and particularly during the very active six business days of every week.

As those familiar with the Grand Central Terminal know, trains enter and leave the station on two levels—designated upper and lower levels. The lower level is devoted mainly to what is classed as suburban trains, which come and go at relatively short intervals, especially during the peak-hour periods of the morning and the late afternoon. Many of these trains are made up of only a few cars; and a goodly number of them are operated without locomotives—being of the multiple-unit electric type that can be run in either direction by merely shifting the point of control from one end to the other.

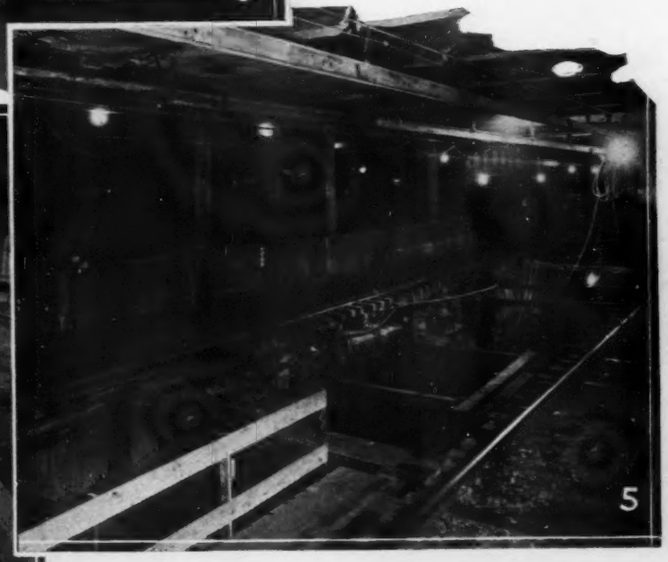
When the Grand Central Terminal was constructed, a smaller or lower-level inner loop was provided that was large enough to accommodate the equipment of suburban trains then in service. The terminal engineers realized, however, that a loop ample enough to take care of trains made up of standard equipment would ultimately be required. Accordingly, they designed or planned for a larger enveloping loop to be built when conditions should call for it. That loop was to extend from the westerly suburban tracks along a line parallel with 42nd Street, and to swing northward in the proximity of Lexington Avenue and 43rd Street. From that point still northward the loop was to run until it was near 49th Street where it was to connect with the regular outgoing tracks. Only part of this loop was built at the time of the completion of the terminal. That is to say, the westerly and southerly parts were finished as far as the point near Lexington Avenue and 43rd Street. Generally speaking it had the form of a great letter "J". Subsequently, the lower end of the "J" was extended to 45th Street in order to accommodate the switching of longer trains. The upper-level loop was finished when the terminal was constructed, but the lower-level loop remained uncompleted for some years.

Augmented traffic, later on, emphasized the need of the complete loop so as to provide greater flexibility in the handling of trains. The razing of certain buildings over the terminal area preparatory to rearing larger and more modern ones gave the railroad the opportunity to finish the loop under relatively favorable conditions. We say relatively, because some of the excavating for the loop could be done only beneath large standing structures, and it was necessary that every precaution be taken to protect them against damage during the prosecution of the work. We shall not enumerate the various buildings that had to be safeguarded during the excavating of the tunnel or trench in which Loop Track No. 200 is to be laid. The names would mean nothing to many of our readers, despite the local prominence of some of the structures.

The buildings reared above the upper and lower train levels at the terminal are supported by columns that rest on rock beneath the tracks; and none of that rock could be removed close to any of the supports until ample provision was made for their security by transferring the loads to supplementary supports. Certain of the buildings that had to be thus underpinned rise high above neighboring streets; and the loads in question had to be shifted to points below the level of the new track—in fact, 22 feet below their established footings. Ordinary methods of



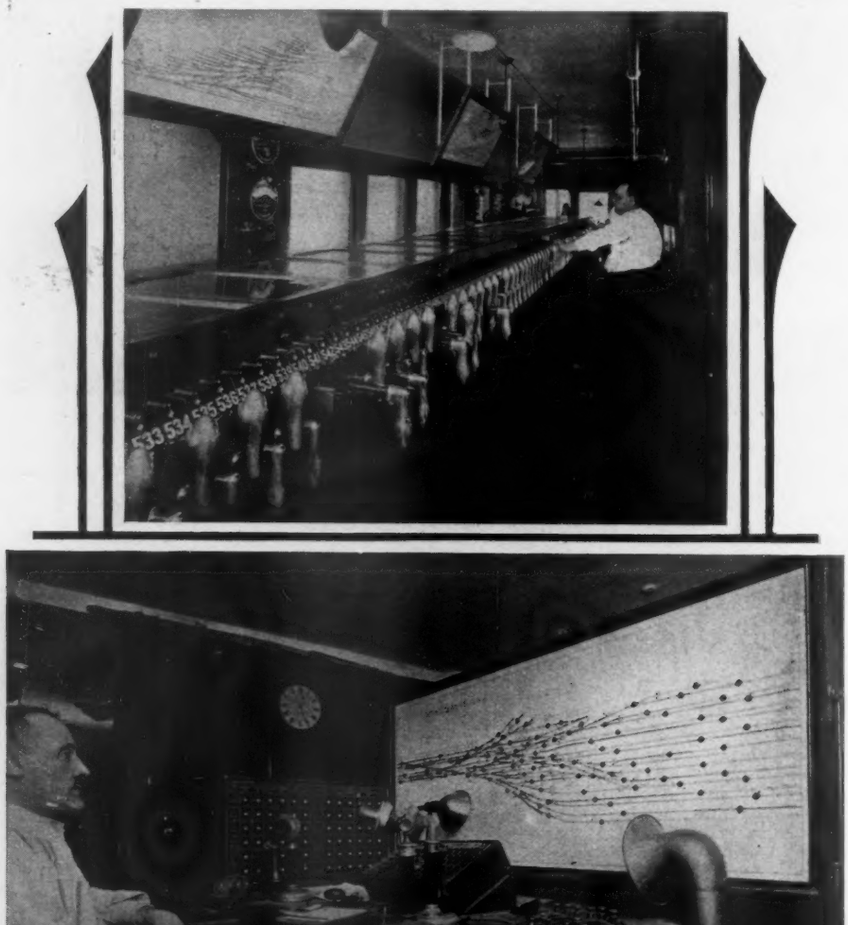
Left—Underground blacksmith shop, at Grand Central Terminal, equipped with an Ingersoll-Rand No. 50 sharpener and two No. 26 oil furnaces. Right—Taking out 36-inch cores in sinking holes with a WS "Calyx" drill during reconstruction work at the Grand Central Terminal.



1—Excavating trench in rock so as to get a horizontal needle girder in place beneath a column supporting a towering building. 2—Shifting a heavy rope mat with a DU air hoist preparatory to lowering it in position for a blast. 3—Using a CC-45 paving breaker to clear away a section of a reinforced-concrete wall. 4—Two X-71's, mounted on a quarry bar, drilling and broaching rock in the cut for Lower-level Track No. 200. 5—Wider view of the open cut for Track No. 200. The utmost care was exercised so as not to interfere with or endanger passing trains.

shoring could not be employed, because timbers used for that purpose might have obstructed or interrupted the operation of trains; and the engineers had to see to it that nothing impeded regular traffic. The solution of the difficulty was something of a novelty, and evidences just how apparatus developed for a particular field of service may be adapted advantageously to another.

The trench excavated in solid rock for Lower-level Track No. 200 runs between two parallel lines of columns. Under one of the buildings there were five columns in each line, and these extended partly into the tunnel area. The load on each column was transferred to two supplementary columns which, in their turn, where placed so that they would stand upon solid rock several feet lower than the tops of the new rails. Each hole or shaft for these supplementary columns had to be 22 feet deep and not less than 3 feet in diameter. Space was limited, and the work had to be done with the least possible use of shattering explosives. All told, twenty shafts or wells had to be sunk. The contractor, the Thomas Crimmins Contracting Company, knew that the work could be done by line drilling and broaching—that is, drilling a circle of closely spaced holes and shattering the core loose with successive charges of dynamite. That procedure would have entailed much time and labor, together with frequent shooting. Again, using ordinary rock drills for the job would have necessitated making the holes 4 feet in diameter so as to have room enough for the men to operate once they had got below the surface of the ledge.



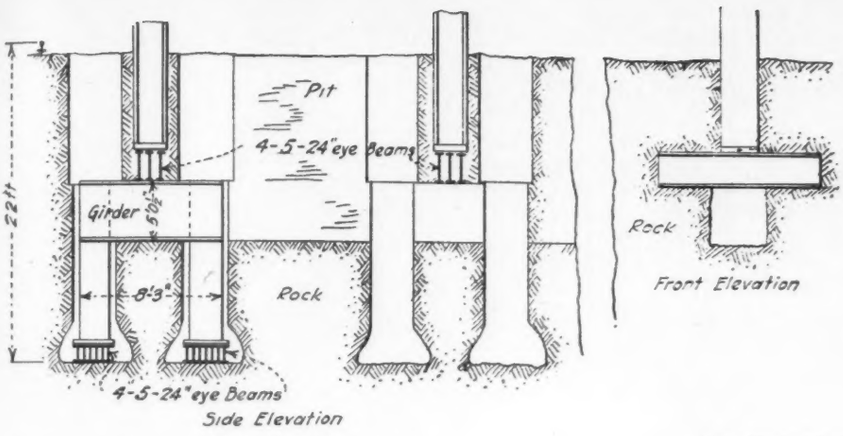
Top—Interlocking signal tower which controls the movements of all inbound and outbound trains.
Bottom—This is tower "A" in the Grand Central Terminal. Every train movement is indicated by a flashing light on the upright board before the dispatcher.

The puzzling situation was solved by recourse to the use of a Class WS "Calyx" drill. This particular form of the "Calyx" drill was developed to aid in the economical quarrying of slate and other stones. It is a rotary core-cutting machine that employs chilled shot as the abrasive agent in working downward into rock. The shot bit—that part of the apparatus that continually presses the shot against the rock to be cut—is a cylindrical drum formed of welded steel plate. This bit is revolved by a line of extension rods attached to the drill spindle, the drill head being chain driven from a 15-hp. electric motor. When the drum had penetrated 2½ to 3½ feet into the rock, a small hole was drilled down the center of the core and three other holes, about equally spaced, were drilled around the edge of the core. A quarter of a stick of dynamite in each hole was usually sufficient to fracture the core so that it could be readily removed.

The two 36-inch holes for each column were drilled on opposite sides of each column and centered on the line that passes through the associate group. The "Calyx" drill made the twenty 3-foot holes—all to the same depth of 22 feet—at an average rate of 12 inches an hour. No shoring was required except for a brief while as a precautionary measure during the transfer of the load from the single column to the two auxiliary columns placed in the flanking holes. Had the holes been drilled and broached, as previously mentioned, and the shafts been 4 feet in diameter, it would have necessitated excavating under a charged third rail and right up against the I-beam grillage upon which each column rested. The use of the "Calyx" drill enabled the contractor to save time and money; it obviated the employment of hampering all-around shoring; and it reduced the use of dynamite to a minimum. Now let us see how the load on each of the original columns was finally transferred to the two new columns.

As constructed in the first place, each of the ten columns was set on a grillage composed of from three to five I-beams—ranging from 18 to 24 inches—disposed horizontally and at right angles to the line of columns. Those grillages rested on the solid rock of the ledge that underlies the Grand Central Terminal. The "Calyx" drill holes are at right angles to the several grillages. One phase of the contractor's task was to place beneath each grillage a massive needle girder 8 feet 3 inches long; to secure that girder to two new steel columns standing upright in the adjacent wells; and then to pull the girder and the attached columns up until the girder rested snugly against the underside of the original grillage. Incidentally, let us mention that the base of each new column was secured to its own footing or grillage which was made up of a number of 24-inch I-beams varying in length from 5 to 7 feet.

For the purpose of placing the needle girders in position, trenches were excavated between the original columns and cuts were made through the rock underlying the old grillages. The cuts in each case had to be 5 feet deep, from 24 to 30 inches wide, and from 5 to 8 feet long. Horizontal line holes, on 4-inch centers, were drilled on two sides vertically and immediately beneath the old grillage. The holes on one side and under the grillage were broached—leaving that side

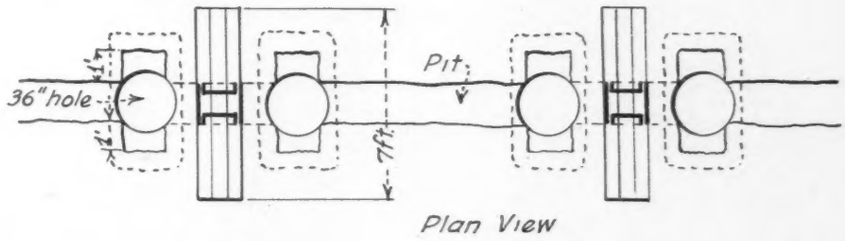


All told, the contractor has been obliged to excavate 17,000 cubic yards of rock; and he has done this work successfully notwithstanding the fact that there have been 197 train-movements daily on adjacent tracks. The job has called for speed, safety, and economy—three requirements difficult to harmonize; and the completion of the work in the time occupied reflects much credit on all concerned. The undertaking has been supervised or the railroad by Mr. F. B. Freeman, Chief Engineer of the New York Central Railroad Company; and Col. Frederick A. Snyder, Engineer, has been in charge for the Thomas Crimmins Contracting Company.

and the top clear. The core remaining was then shot out toward the cleared side by putting charges in the unbroached side holes. The drilling was done with Ingersoll-Rand stopers and "Jackhamers". The need for the trenches and for the cuts under the old grillages becomes apparent upon consideration of the accompanying drawings. The spacing between neighboring columns was about 20 feet between centers. One pit between a pair of original columns made it possible to lower and to slide into place two needle girders—one for each column.

To provide space at the bottoms of the "Calyx" drill holes in which to place the I-beams forming the grillages for the supplementary new columns, the wells were flared out—using S-49 "Jackhamers" to excavate the rock. One of our drawings illustrates this. With the grillages for two associate supplementary columns in place, and with billets on top of them, then the new columns were set up in the adjoining wells. Next, the new needle girder was slid into position by way of the excavated trench and the cut beneath the old grillage. The needle girder was then fitted tight to the flanges of the new columns and drawn up snugly against the bottom of the old grillage by two 10-ton chain blocks—one secured to each end of the girder. Steel shims were driven between the top of the new girder and the bottom of the old grillage to fill any space and to complete the contract. Next, holes were drilled in the flanges of the new columns—using shop holes in the new girder as templates—and the columns and girders were then riveted together. After that concrete was poured into the bottoms of the wells around the grillages of the new columns. With this work completed, the chain blocks were removed. This procedure was varied in a measure to meet differing conditions, but in principle was as described.

When the new columns were set to take the loads of the original ten columns, the excavating of the tunnel or trench for Track No. 200 was pushed ahead; and this could be done safely because the columns on each side of the cut were amply supported by a wall of rock interspersed with 3-foot columns of concrete reinforced with their embedded massive steel. From end to end, the excavation in rock—partly open cut and partly tunnel—is 860 feet long. For a distance of 300 feet, northward from the southern end of the job, the excavation is an open cut made by drilling and broaching along the sides and by benching intermediate rock in two successive lifts. The open cut is 20 feet wide and 21 feet deep.



From the northern end of the open cut onward, the method pursued in excavating the rock was as follows: Trenches were dug under the rails and two 12-inch steel H-beams were placed in line with the track. Part of these H-beams had continuous joints, while the balance of the tracks was supported by two H-beams, with broken joints, placed under each rail. The ballast, dirt, and loose rock were removed; and line holes were drilled on each side of the cut on about 4-inch centers. The rock was taken out in benches; and the tracks were supported on timber bents.

The machine gun that shoots a hail of lead balls with high-pressure air.

NEW HEAT-RESISTING ALLOY

AN important advance in heat-resisting steels has been made by Hadfields, Ltd., of Sheffield, according to a recent announcement from that company's offices. Hitherto, says *The Engineer*, the practical limit of temperature for the continuous use of these special steels has been about 2,012°F. This, although in itself an extremely high temperature to expect steel to withstand without serious wastage due to oxidation, left room for further improvement if the demands of industrial progress were to be fully met. With the new alloy, higher working temperatures are permissible. In addition to this high resistance to oxidation, the alloy possesses unusually high electrical resistance—some fourteen times that of pure iron, which makes it of especial value in the construction of electric furnaces.

MACHINE GUN "FIRED" WITH HIGH-PRESSURE AIR

A PNEUMATIC gun has been developed that shoots lead balls such as are discharged from air rifles. These balls are poured into the magazine opening in the top of the gun in quantities of about 300. The weapon picks them up one at a time and shoots them with considerable velocity. Using compressed air at a pressure of 200 pounds per square inch, the balls will perforate wood ¼ inch thick at a distance of 100 feet.

The pneumatic gun was primarily designed for use in shooting galleries; but it is suggested that it could be utilized to advantage in the preliminary training of machine gunners for the army and the navy. The model illustrated is of the same size as the service machine gun, which it is not unlike in appearance.

AIR AIDS IN CLEANING AN OIL-COATED STATOR

POWER-PLANT operators may be interested in the following cleaning job that at first seemed to offer difficulties but, with the aid of compressed air, was done with complete satisfaction and at low cost. Faulty ventilation of the stator of a 20,000-kv-a. water-wheel generator was found to be the cause of the machine running hot. Upon investigation it was revealed that oil vapor—working its way in around the shaft—had coated the entire surface of the stator with a film of oil. Dust and dirt adhering to this film had formed a thick gummy mass that had clogged nearly 40 per cent of the stator's air ducts.

How to get rid of the oil was what puzzled the engineers; because every trace of it had to be removed if an early repetition of the trouble was to be avoided. Here is how they went about it. Stiff bristle brushes with wire handles, such as are used for cleaning small gun barrels, served to loosen and to dispose of the bulk of the dirt adhering to the inner surfaces of the air ducts. The outer surface of the stator was gone over with fiber scrapers. Then was applied a solution consisting of equal parts of gasoline and carbon-tetrachloride. This was atomized and blown into the ducts and over the surfaces with compressed air, thus making it possible effectually to dislodge the remaining dirt and to cut the film of oil. The job was concluded by wiping the surfaces with clean rags. All this was done without injury to the insulation of the coils and in less than eighteen hours.

LEICESTERSHIRE GRANITE INDUSTRY FILMED

FOLLOWING a practice that has been established for some time in the United States with a view to exploiting American industrial life, 2,000,000 and more movie fans in England were recently provided with similar thrills in the form of a sound film entitled, *The Story of Leicestershire Granite*. Between 4,000 and 5,000 workmen are employed in the granite industry of that section.

No pains were spared to illustrate the quarrying and handling of this material in an interesting fashion; and apparatus costing substantially $40,000 was used in recording the film. One outstanding feature of the picture is the reproduction of a large blast which brought down approximately 1,500 tons of granite. The "mike" was placed in a barrel during the recording of this blast. The taking and exhibition of the film in 300-odd *cinemas* were timed to take place when the majority of British local authorities were considering tenders for the annual supply of roadbuilding materials.

The reclaimed-rubber industry is rapidly becoming one of major importance—the product, thanks to chemical research, now possessing qualities closely akin to those of crude rubber.

INDIAN STORIES FROM THE PUEBLOS, by Frank G. Applegate. An illustrated volume of 178 pages, published by J. B. Lippincott Company, Philadelphia, Pa. Price, $3.50.

IN this extremely interesting and entertaining book the author has given the world unusual but authoritative pictures of the Pueblo Indians and their beliefs—they are veritable folklore of an ancient people about which most of us know little if anything, a people that have inhabited sections of our great Southwest for ages. Witter Bynner, in a foreword to the book, says this of Mr. Applegate's identification with the Indians and life among the Pueblos: "Not only is he a familiar in the Tewa villages around his home town, Sante Fe, but months at a time he has lived in Hopi villages, lived the Hopi life, felt Hopi feelings, studied and revived Hopi art among the native pottery-makers, painted Hopi persons and ceremonies, and listened meantime to such stories as he has caught for us in this volume".

AMERICAN INDUSTRY AND COMMERCE, by Edward Dana Durand. An illustrated work of 653 pages, published by Ginn & Company, Boston and New York. Price, $4.00.

THE purpose of the author has been to present in this volume a general picture of American industry and commerce. In order to make our world position understandable, he has set forth systematically the major facts regarding the present riches of the country, the character and the magnitude of its industries and commerce, and the history of its material development, especially during recent decades. He has sought to discover the basic causes of American prosperity and progress, and to sketch the more important of those proximate and derivative forces for efficiency into which these underlying factors translate themselves. Finally, with commendable clarity, he undertakes to discuss the general economic status and trends of the country in relation to the well-being of the masses of the population.

THE ST. LAWRENCE WATERWAY PROJECT, by George Washington Stephens. An illustrated volume of 460 pages, published by Louis Carrier & Company, New York City. Price, $7.50.

THE author undertook the writing of this book because of the importance of the subject and the uninformed status of the public at large in Canada and in the United States. As he writes in his foreword: "Apart from a few authoritative opinions expressed by students of the problem, such comment as I have heard has been mostly prejudiced by sentiment or biased by self-interest. The main object of this book, therefore, is to place essential and authoritative information within reach of Canadians and citizens of the United States, whose interests are mutually involved. An attempt has been made to do this in an impartial spirit." The work is a valuable one, and any one that reads it will be better informed and better able to discuss the project.

GEORGE EASTMAN, by Carl W. Ackerman. An illustrated work of 522 pages, published by Houghton Mifflin Company, New York City. Price, $5.00.

TO the vast majority of people, the name Eastman means the Kodak and photographic films—little realizing that these, in themselves, are but symbols of an industrial success that has brought infinite pleasure and satisfaction to many millions of people. The present book deals, of course, with Mr. Eastman's achievements in business, but it also reveals Eastman the man and the manner in which he had grown during the outstanding periods of his career. The life of George Eastman is at once an inspiration and an example; and the author has dealt with his subject understandingly and sympathetically without at any time becoming fulsome in his treatmen'.

THE RUN OF THE TWENTIETH CENTURY, by Edward Hungerford. An illustrated book of 110 pages, published by the Du Bois Press, Rochester, N. Y. Price, 50 cents.

THE Twentieth Century Limited of the New York Central Lines is a crack train of international repute. It is no longer a single train, because it has become too popular to satisfy the public and permit hauling as a single unit. Therefore, the Twentieth Century Limited is today a group of nine expresses each of which makes the run between New York and Chicago within the span of twenty hours. Mr. Hungerford has pictured for us all phases o' the make-up and the operation of these trains; and he tells us in a fascinating fashion of the multiple service that renders their running possible.

FUNCTION OF NATURAL GAS IN THE PRODUCTION OF OIL, by H. C. Miller, Senior Petroleum Engineer, U. S. Bureau of Mines. An illustrated volume of 267 pages, printed by the American Petroleum Institute, New York City. Price, $1.00.

THIS book is the outcome of an effort on the part of the American Petroleum Institute to increase efficiency in oil production. In 1927 the Institute undertook to collect data relative to the function of gas in the production of oil, and a committee, known as the Gas Conservation Committee, was organized to make the necessary arrangements to that end. The facts so obtained now appear in this volume. The book is a notable contribution, and contains a great deal of worthwhile information on a subject of much economic importance.